Test Monitoring Center
6555 Penn Avenue
Pittsburgh, PA 15206-4489
(412) 365-1000

MEMORANDUM: 01-031

DATE: May 4, 2001

TO: Mr. Ted Selby, Chairman ASTM D02.B07

FROM: Thomas Schofield & Richard Grundza

SUBJECT: TMC Bench Reference Test Monitoring from April 1, 2000 through March 31, 2001

We respectfully submit the TMC's ASTM D02.B07 Bench Reference Test Monitoring Semiannual Report, with statistical summaries broken down by test area (Attachment 1).

Precision and severity are monitored by comparing a recent period of reference test performance to "target" performance (as determined by the surveillance panels), and to previous periods. The TMC monitors test precision by a pooled standard deviation (pooled s), and test severity by mean Δ/s, where:

Pooled s = Standard deviation pooled across reference oils
(i.e., The pooled precision of the test this period.)
Δ/s = [(Result) - (Target mean)] / (Target s)
(i.e., "How many standard deviations from the target mean is this test?")
Mean Δ/s = [Σ (Δ/s)] / n (across reference oils)
(i.e., "On average, how many standard deviations from the target mean are all the operationally valid calibration tests for each period?")

Notice that the severity estimates (mean Δ/s) are independent of oil performance because they are normalized into (target) standard deviations for each oil. Also, using a pooled s for precision simplifies the interpretation of precision across all reference oil performance levels. These two calculations allow us to combine all calibration performance levels into single precision and severity estimates each period for a general comparison of current test performance to target performance, and to prior periods. Individual oil targets, and current performance summaries by oil**,** are also reported (Attachments 2 and 3).

The tables in Attachment 1 comparing current and previous period precision and severity have become too large to conveniently show the entire prior report periods. To keep the information succinct, intermediate overlapping periods are not included, and some of the oldest annual comparison periods have been eliminated.

The lab codes in this report are cross-referenced, as they were in previous reports. That is, in this report, Lab A represents the same lab in each section, which is the same as Lab A in previous reports, and should remain the same lab in future reports. (The initial TMC PCEOCP Bench Test Report, of November 8, 1996, did not cross reference the labs.)

All operationally valid test data and severity plots are available on the TMC's website. Please contact the TMC if you require further information.

Attachments

c: J. Zalar
M. Lane
ftp://tmc.astm.cmri.cmu.edu/docs/bench/bo7semiannualreports/mem01-031.pdf

D02.B07 mailing list contacts notified by e-mail of ftp posting on the TMC's website.

Attachment 1

ASTM Test Monitoring Center

Semiannual Report

ASTM D02.B07 Bench Reference Test Monitoring
From April 1, 2000 through March 31, 2001

RR D02-1393: Volatility by Gas Chromatography (VGC by D 2887 Extended)

STATUS

Table 1 summarizes the reference tests reported to the TMC this period (6 labs reporting):

TABLE 1

	No. of Tests
Statistically Acceptable and Operationally Valid	21
Operationally Valid but Failed Acceptance Criteria	1
Operationally Invalid	1
Total	**23**

Fail Rate of Operationally Valid Tests: 4.5%

Table 2 is a breakdown of the statistically unacceptable tests.

TABLE 2

Reason for Fail	No. of Tests
Sample Evaporation Loss Severe	1

INDUSTRY PERFORMANCE

Table 3 shows the current Industry precision and severity for the Sample % Volatized @ 371°C test parameter for all operationally valid tests for the report period. (First calibration test completed 5/10/96.)

TABLE 3

% Volatized @ 371°C, area %	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study	240	235	0.70	-----
5/10/96 through 3/31/97	31	26	0.78	-0.19
4/1/97 through 3/31/98	35	30	0.61	-0.26
4/1/98 through 3/31/99	36	31	0.74	-0.02
4/1/99 through 3/31/00	36	31	0.84	0.15
4/1/00 through 3/31/01	22	17	0.73	0.71

Table 4 shows the current severity for the Sample % Volatized @ 371°C parameter for each lab for all operationally valid tests for the report period.

TABLE 4

	n	Mean Δ/s
Lab A	10	1.20
Lab B	2	-0.42
Lab D	4	0.90
Lab G	2	-0.48
Lab H	2	0.20
Lab U	2	0.66

PRECISION AND SEVERITY

Only eight D2887 Extended calibration tests from three labs (labs A, D & U) were received by the TMC in the past six months. Most of the participating laboratories that run volatility by gas chromatography are calibrating with the TMC using the new D6417 test method. The TMC anticipates that future calibration testing using D2887 Extended will drop off considerably.

The diminishing number of reported tests will make future (meaningful) precision and severity estimates difficult. For this one-year report period, 64% of the 22 operationally valid tests used to make the precision and severity estimates were run in the first half of the year period, before many of the labs began calibrating exclusively with the D6417 method.

D2887 Extended precision for this report period has improved to near target levels. Severity is graphically represented in Figure 1 (attached).

Overall severity has become unusually severe, primarily due to Lab's A and D recently running significantly severe. Both labs combined contributed 64% of the total operationally valid tests this period (and 88% of the operationally valid tests over the past six months). As reflected in Figure 1, over the history of this test severity has shifted from somewhat mild, to on target, to slightly severe, to quite severe. Labs G and S had been the extreme mild performers since TMC monitoring began. However, since these two labs have stopped contributing D2887 tests, they no longer offset the severely performing labs. In the last six months of the report period, eight operationally valid tests were reported to the TMC. One of those tests was 1.2 s severe of target and three tests were more than 1.5 s severe.

TMC MEMORANDA

There were no TMC technical memoranda issued this report period for the D2887 Extended test method.

METHOD UPGRADE

The TMC has been monitoring method D6417 since October 2, 2000. D6417 is expected to replace all references to D2887 Extended in Oil Specification D4485 (including previous API categories). The TMC will monitor D2887 Extended until instructed to stop by D02.B07.

D6417: Estimation of Engine Oil Volatility by Capillary Gas Chromatography

STATUS

Table 5 summarizes the reference tests reported to the TMC this period (6 labs reporting):

TABLE 5

	No. of Tests
Statistically Acceptable and Operationally Valid	16
Operationally Valid but Failed Acceptance Criteria	2
Operationally Invalid	3
Total	**21**

Fail Rate of Operationally Valid Tests: 11.1%

Table 6 is a breakdown of the statistically unacceptable tests.

TABLE 6

Reason for Fail	No. of Tests
Sample Area % Volatized Mild	1
Sample Area % Volatized Severe	1

INDUSTRY PERFORMANCE

Table 7 shows the current Industry precision and severity for the Sample Area % Volatized @ 371°C test parameter for all operationally valid tests for the report period. (First calibration test completed 10/5/00.)

TABLE 7

Area % Volatized @ 371°C	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study	107	101	0.46	-----
10/5/00 through 3/31/01	18	15	0.50	1.42

Table 8 shows the current severity for the Sample Area % Volatized @ 371°C parameter for each lab for all operationally valid tests for the report period.

TABLE 8

	n	Mean Δ/s
Lab A	6	1.33
Lab B	4	-0.27
Lab D	2	-1.23
Lab G	2	0.63
Lab H	2	0.84
Lab U	2	1.64

PRECISION AND SEVERITY

Note the abbreviated period for collecting calibration data (first TMC calibration completed 10/5/ 01). Precision is very near target for the report period. Severity is substantially severe of target. Severity is represented graphically in Figure 2. While there seems to be an overall severe trend in the calibration data, there is also an indication of recent leveling to target. More calibration data will need to be collected to better assess the true state of D6417 calibration testing. Individual lab n sizes are quite small at this point to give meaningful severity estimates.

TMC MEMORANDA

There were three TMC technical memoranda issued this report period for the D6417 test method:

Memo 00-122, September 13, 2000, D6417 (Volatility by GC) Monitoring
Memo 00-123, September 14, 2000, D6417 Test Report Package
Memo 00-132, October 6, 2000, D6417 Report Package Upgrade

D5480: Engine Oil Volatility by Gas Chromatography (VGC by D5480)

STATUS

Table 9 summarizes the reference tests reported to the TMC this period (2 labs reporting):

TABLE 9

	No. of Tests
Statistically Acceptable and Operationally Valid	5
Operationally Valid but Failed Acceptance Criteria	2
Total	**7**

Fail Rate of Operationally Valid Tests: 28.6%

Table 10 is a breakdown of the statistically unacceptable tests.

TABLE 10

Reason for Fail	No. of Tests
Sample Evaporation Loss Mild	1
Sample Evaporation Loss Severe	1

INDUSTRY PERFORMANCE

Table 11 shows the current Industry precision and severity for the Sample % Volatized @ 371°C test parameter for all operationally valid tests for the report period. (First calibration test completed 5/20/96.)

TABLE 11

% Volatized @ 371°C, mass %	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study	140	135	0.65	-----
5/20/96 through 3/31/97	14	9	0.70	-0.65
4/1/97 through 3/31/98	16	11	0.27	-0.61
*4/1/98 through 3/31/99	15	10	0.63	-0.92
4/1/99 through 3/31/00	11	6	0.50	-0.88
New Targets Effective 12/7/99	52	47	0.49	-----
4/1/00 through 3/31/01	7	2	0.36	0.06

*Exclusion of test result that was more than 7 standard deviations mild of target (excluded per surveillance panel's recommendation).

Table 12 shows the current severity for the Sample % Volatized @ 371°C parameter for each lab for all operationally valid tests for the report period.

TABLE 12

	n	Mean Δ/s
Lab A	6	0.02
Lab G	1	0.35

PRECISION AND SEVERITY

Only two tests from one lab (lab A) were received by the TMC in the past six months. With the introduction of the D6417 GC method, the two other participating laboratories have indicated that they likely will no longer be calibrating with the TMC using the D5480 test method. The TMC has no reason to believe there will be more than one lab calibrating with the TMC in the immediate future. The very limited amount of data this will generate will makes the TMC's statistical monitoring of the method rather difficult, if not meaningless (while estimates for precision and severity can be generated, they may not have much practical meaning with only one lab calibrating one instrument four times a year).

Overall precision has improved compared to the new targets set in December 1999. Overall Severity is on target. However, only two tests were reported the past six months, one failing severe, the other mild, thus canceling each other to some extent in the overall severity estimate. Severity is represented graphically in Figure 3A. Figure 3B is the same severity plot showing when the revised targets were implemented.

TMC MEMORANDA

There were no TMC technical memoranda issued this report period for the D5480 test method.

D5800: Evaporation Loss of Lubricating Oils by the Noack Method

STATUS

Table 13 summarizes the reference tests reported to the TMC this period (11 labs reporting):

TABLE 13

	No. of Tests
Statistically Acceptable and Operationally Valid	42
Operationally Valid but Failed Acceptance Criteria	5
Operationally Invalid	8
Total	**55**

Fail Rate of Operationally Valid Tests: 10.6%

Note: One additional test was reported late in the period but was not resolved as of this writing. This one test is excluded from all reported statistics this period pending resolution.

Table 14 is a breakdown of the statistically unacceptable tests.

TABLE 14

Reason for Fail	No. of Tests
Sample Evaporation Loss Mild	2
Sample Evaporation Loss Severe	3

INDUSTRY PERFORMANCE

Table 15 shows the current Industry precision and severity for the Sample Evaporation Loss test parameter for all operationally valid tests for the report period. (First calibration test completed 5/1/96.)

TABLE 15

Sample Evaporation Loss, mass %	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study	180	175	0.51	-----
5/1/96 through 3/31/97	31	26	0.68	0.70
4/1/97 through 3/31/98	22	17	0.72	0.75
4/1/98 through 3/31/99	28	23	0.59	0.49
4/1/99 through 3/31/00	33	28	0.42	0.90
New Targets Effective 9/26/00	178	175	0.56	-----
4/1/00 through 3/31/00	47	42	0.69	0.98

D5800: Evaporation Loss of Lubricating Oils by the Noack Method, continued

Table 16 shows the current severity for the Sample Evaporation Loss parameter for each lab for all operationally valid tests for the report period.

TABLE 16

	n	Mean Δ/s
Lab A	8	0.56
Lab B	7	1.52
Lab D	2	0.45
Lab E	2	1.39
Lab G	8	1.17
Lab H	1	3.04
Lab I	4	1.42
Lab J	5	0.71
Lab L	2	-1.28
Lab R	5	1.28
Lab U	3	0.64

PRECISION AND SEVERITY

Effective September 26, 2000, the TMC began monitoring the three Noack procedures under the newest D5800 test method. Also effective September 26, 2000, new reference oils, targets and acceptance bands were implemented for TMC calibration monitoring. Oils 51, 53 and 54 were dropped, oil 58 was introduced and targets for oils 52 & 55 were revised. The statistical estimates this period are an overlap of the monitoring of the two periods (before and after new targets and oils) with about 72% of the data weighted using the new targets. Severity estimates are made using the performance targets that were in place at the time that each test was reported to the TMC.

Overall precision is somewhat worse than target precision. Overall severity is significantly severe of target, with 11 of the 12 participating labs performing severe for the report period. The severity trend is represented in Figures 4A and 4B. Figure 4B shows that a strong severe trend that started a long time before new targets were established continues right on through the effective date of the new performance targets and up to the present time. A leveling to target would have been expected, particularly after the performance targets were updated in September 2000.

TMC MEMORANDA

There were three TMC technical memoranda issued this report period for the D5800 test method:
Memo 00-121, September 8, 2000, New D5800 Noack Procedures and Targets.
Memo 00-133, October 6, 2000, D5800 Report Package Upgrade
Memo 00-150, October 23, 2000, D5800 Test Method Update.

There was also an e-mail message issued to test participants by Thomas Schofield on December 18, 2000, Subject D5800 Calibration QC Samples Requirement. This message clarified the TMC's position on the test method's ambiguous wording concerning the use of QC Check Samples in each of the procedures.

D5133: Low Temperature, Low Shear Rate, Viscosity/Temperature Dependence of Lubricating Oils Using a Temperature Scanning Technique (Gelation Index or GI)

STATUS

Table 17 summarizes the reference tests reported to the TMC this period (11 labs reporting):

TABLE 17
Reference Tests

	No. of Tests
Statistically Acceptable and Operationally Valid	59
Operationally Valid but Failed Acceptance Criteria	7
Operationally Invalid	3
Total	**69**

Fail Rate of Operationally Valid Tests: 10.6%

Table 18 is a breakdown of the statistically unacceptable tests.

TABLE 18
Reference Tests

Reason for Fail	No. of Tests
Gelation Index Mild	5
Gelation Index Severe	2

INDUSTRY PERFORMANCE

Table 19 shows the current Industry precision and severity for the Gelation Index and test parameter for all operationally valid tests for the report period. (First calibration test completed 4/20/96.) "Initial Tests" includes reference and donated tests; subsequent listings include only reference tests.

TABLE 19

Gelation Index	n	df	Pooled s	Mean Δ/s
Initial Tests 4/20/96 through 11/27/96	178	173	6.37	-----
4/20/96 through 3/31/97	60	55	5.40	-0.06
4/1/97 through 3/31/98	64	59	5.20	-0.12
4/1/98 through 3/31/99	68	63	6.67	-0.07
4/1/99 through 3/31/00	62	57	6.30	0.09
*4/1/00 through 3/31/01	65	60	5.93	-0.15

*Excludes one data point more than 13 standard deviations from target, on TMC 52, as a rare event. See the TMC's December 2000 report for more information.

D5133: Low Temperature, Low Shear Rate, Viscosity/Temperature Dependence of Lubricating Oils Using a Temperature Scanning Technique (Gelation Index or GI), continued

Table 20 shows the current severity for the Gelation Index for each lab for all operationally valid tests for the report period.

TABLE 20

	N	GI Mean Δ/s
*Lab A	12	0.20
Lab B	12	0.38
Lab D	6	0.28
Lab E	3	-2.12
Lab G	10	-0.86
Lab H	3	-0.50
Lab I	4	-0.48
Lab R	6	0.27
Lab S	3	0.08
Lab U	4	0.62
Lab V	2	-2.05

*Excludes one data point more than 13 standard deviations from target on TMC 52.
See the TMC's December 2000 report for more information.

PRECISION AND SEVERITY

Note that in June 2000, Section B07 had given approval for the TMC to stop monitoring Gelation Temperature, although the TMC is still collecting this data.

This period, one operationally valid test was reported to be 13.75 standard deviations severe of target. Per approval of Section B07 last December, this data point is excluded form the data set as a rare event (details are fully documented in the last TMC report presented at the December 2000 B07 Meeting).

Overall precision is improved and better than the target precision. Overall Gelation Index severity is only slightly mild of target. Severity is graphically represented in Figure 5 (attached). The figure shows a short-term mild trend from November 2000 to February 2001 that has leveled back to target. While precision and severity are quite good, the failure rate of operationally valid tests is more than double the expected rate of 5%. This is unusual given that the precision and severity are both close to target and the overall number of reported tests is reasonably high (large n size).

TMC MEMORANDA

There was one TMC technical memorandum issued this report period for the D5133 test method:

Memo 00-013, February 2, 2000, D5133 (Gelation Index) Procedure Update.

D6335: Determination of High Temperature Deposits by Thermo-oxidation Engine Oil Simulation Test (TEOST)

STATUS

Table 21 summarizes the reference tests reported to the TMC this period (4 labs reporting):

TABLE 21

	No. of Tests
Statistically Acceptable and Operationally Valid	16
Operationally Valid but Failed Acceptance Criteria	2
Operationally Invalid	2
Total	**20**

Fail Rate of Operationally Valid Tests: 11.1%

Table 22 is a breakdown of the statistically unacceptable tests.

TABLE 22

Reason for Fail	No. of Tests
Total Deposits Severe	2

INDUSTRY PERFORMANCE

Table 23 shows the current Industry precision and severity for the Total Deposits test parameter for all operationally valid tests for the report period. (First calibration test completed 2/13/96.)

TABLE 23

Total Deposits	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study	54	52	4.18	-----
4/1/96 through 3/31/97	44	42	6.22	0.28
4/1/97 through 3/31/98	41	39	4.24	-0.10
4/1/98 through 3/31/99	36	34	5.68	-0.49
4/1/99 through 3/31/00	30	28	5.67	0.14
4/1/00 through 3/31/01	18	16	8.45	0.40

Table 24 shows the current severity for the Total Deposits parameter for each lab for all operationally valid tests in the report period.

TABLE 24

	n	Mean Δ/s
Lab A	6	0.24
Lab B	8	-0.09
Lab G	6	1.64
Lab I	2	-0.04

D6335: Determination of High Temperature Deposits by Thermo-Oxidation Engine Oil Simulation Test (TEOST), continued

PRECISION AND SEVERITY

Overall precision is exceptionally poor for the calibration tests this period (historic worst) and overall severity is moderately severe of target. These trends are similar to six months ago, though the precision has worsened slightly since then. One test reported as operationally valid was more than 6 s severe of target (Lab G, Oil 71).

The severity trends are graphically represented in Figure 6 (attached). All the short term up and down patterns in the plot are unusual compared to prior history and indicative of exceptionally poor precision.

In summary, from April 1, 1998 (and particularly from July 1, 1998) through September 1998, we observed an exceptionally strong industry-wide mild trend in the TEOST reference data that was not reflected in the overall mean Δ/s for that report period due to an earlier severe trend. From October 1998 through October 1999, we observe that severity has leveled closer to targets (mild bias) for the entire period. Since October 1999, the severity plot (Figure 6) shows a considerable amount of variability in the calibration data, and a moderate overall severe bias. There does seem to be some signs of leveling severity back to on target since October 2000.

TMC MEMORANDA

There were no TMC technical memoranda issued this report period for the D6335 test method.

TEOST MHT-4, Draft 17, 00.08.11: Determination of Moderately High Temperature Piston Deposits by Thermo-oxidation Engine Oil Simulation Test (MTEOS)

STATUS

Table 25 summarizes the reference tests reported to the TMC this period (8 labs reporting):

TABLE 25

	No. of Tests
Statistically Acceptable and Operationally Valid	48
Operationally Valid but Failed Acceptance Criteria	4
Operationally Invalid	3
Total	**55**

Fail Rate of Operationally Valid Tests: 7.7%

Table 26 is a breakdown of the statistically unacceptable tests.

TABLE 26

Reason for Fail	No. of Tests
Total Deposits Mild	4

INDUSTRY PERFORMANCE

Table 27 shows the current Industry precision and severity for the Total Deposits test parameter for all operationally valid tests for the report period. (First calibration test completed 9/6/00.)

TABLE 27

Total Deposits	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study (1st half)	28	24	5.50	-----
9/6/00 through 3/31/01	52	48	6.67	-0.46

Table 28 shows the current severity for the Total Deposits parameter for each lab for all operationally valid tests in the report period.

TABLE 28

	n	Mean Δ/s
Lab A	13	-1.07
Lab AB	3	0.77
Lab B	14	0.02
Lab D	2	-0.69
Lab G	10	-0.78
Lab I	3	0.03
Lab R	1	-0.57
Lab V	6	-0.47

TEOST MHT-4, Draft 17, 00.08.11: Determination of Moderately High Temperature Piston Deposits by Thermo-oxidation Engine Oil Simulation Test (MTEOS), continued

IMPORTANT BACKGROUND INFORMATION OF NEWLY MONITORED TEST

This is the first TMC report on MTEOS calibration testing. When the calibration monitoring responsibilities were initially charged to the TMC, there was an urgent need to get MTEOS instruments with TMC calibrated status as quickly as possible. To meet this industry-wide need, a matrix was proposed (MTEOS Matrix 6) to collect data for establishing performance targets and acceptance criteria on the proposed TMC MTEOS reference oils. The first half of the matrix (28 tests total, 7 tests on each of four oils) was used to set preliminary performance targets and to simultaneously evaluate the calibration status of the testing instruments. Meanwhile, the remainder of the matrix was completed, and laboratories calibrating additional rigs donated more tests. The TMC has proposed to the panel chairs updated performance targets and acceptance criteria based on the completed matrix and initial calibration runs, but to date the TMC's proposal has not been approved by the appropriate technical panel under B07. Therefore, the TMC continues to evaluate calibration status using the more limited, "preliminary" data set from Matrix 6. All MTEOS performance estimates in this report are being compared to the preliminary targets (partial matrix results).

PRECISION AND SEVERITY

Note the abbreviated report period because this is a newly monitored test. Overall precision is worse than target. Severity is trending moderately mild of target. Severity is presented graphically in Figure 7. While the overall plot trends mild, it is of note that the severity plot levels closer to target as time progresses (the precision also appears to improve over time). The plot is reasonably level (even slightly severe) for the final few data points in Figure 7. One test reported as operationally valid early on in this period is more than 5 standard deviations mild of target (Lab A, Oil 432). (This result tested as a rare event in the "complete" Matrix 6 data set, and is excluded in the TMC's proposal for updated targets and acceptance bands). The extreme result certainly contributes to the overall mild performance of calibration testing this period. Also, experience demonstrates that newly monitored tests often perform erratically at first, and less so as the participants become more familiar with the operational protocols. Further TMC monitoring will determine if these overall trends actually do improve and stabilize (as the more recently reported calibration data suggests).

TMC MEMORANDA

There were two TMC technical memoranda issued this report period for the MTEOS test method:

Memo 00-142, October 16, 2000, MHT-4 TEOST (MTEOS Report Package and TMC Monitoring
Memo 01-025, March 21, 2001, MHT-4 TEOST Reporting Package (Version 20010208)

Additionally, there was an important e-mail message from (then Surveillance Panel Chair) Henry Wheeler dated September 18, 2000 with information supplied by the TMC concerning the preliminary Matrix 6 results. The proposed targets and acceptance bands in Henry's message were later approved, and are presently in place.

D6082: High Temperature Foaming Characteristics of Lubricating Oils

The TMC has chosen to break down the D6082 calibration statistical analysis by oil. The reasons for doing so are:

1. The two reference oils (1002 and 1007) perform very differently, both in mean performance and precision. There are no other oils providing "intermediate" performance to provide continuity over the entire performance range for an analysis of performance that combines all the reference oils.

2. TMC 1007 has a Foam Stability (one minute after disconnect) target mean performance of zero ml and a target precision (standard deviation) of zero ml. Any negative (mild) result for this parameter is unlikely and any positive result would be "infinitely" severe in standard deviations (Δ/s). For Foam Stability, it is preferable to simply note the number of non-zero occurrences in order to flag any severity trends, and use the 1002 Foam Stability results to both verify and quantify the trend.

3. Introducing a combined 1002 & 1007 statistical analysis for any given period will make it very difficult to make a meaningful comparison to earlier calibration periods which were based only on 1002 calibration data.

Note that in June 2000, the High Temperature Foam Surveillance Panel had given approval for the TMC to stop collecting data for Total Volume Increase.

STATUS

Table 29 summarizes the reference tests reported to the TMC this period (6 labs reporting):

TABLE 29

	No. of Tests
Statistically Acceptable and Operationally Valid	24
Operationally Valid but Failed Acceptance Criteria	7
Operationally Invalid	1
Total	**32**

Fail Rate of Operationally Valid Tests: 22.6%

Table 30 is a breakdown of the statistically unacceptable tests.

TABLE 30

Reason for Fail	No. of Tests
Foam Tendency Severe & Foam Stability Severe (1002)	5
Foam Tendency Mild & Foam Stability Severe (1002)	1

D6082: High Temperature Foaming Characteristics of Lubricating Oils, continued

TMC 1002 INDUSTRY PERFORMANCE

Tables 31 and 32 show the current industry precision and severity for the Foam Tendency, Foam Stability and Total Volume Increase test parameter for all operationally valid tests **on oil 1002** for the report period. (First calibration test completed 5/14/96.)

TABLE 31

1002 Foam Tendency, ml	n	Mean	s_R	Mean Δ/s
Initial Round Robin Study (targets)	32	410.63	58.78	-----
5/14/96 through 3/31/97	32	368.2	106.67	-0.72
4/1/97 through 3/31/98	28	411.6	77.78	0.02
4/1/98 through 3/31/99	29	386.9	71.38	-0.40
4/1/99 through 3/31/00	9	422.2	78.86	0.20
4/1/00 through 3/31/01	17	495.6	232.46	1.45

TABLE 32

1002 Foam Stability @ 1 min., ml	n	Mean	s_R	Mean Δ/s
Initial Round Robin Study (targets)	32	37.81	45.41	-----
5/14/96 through 3/31/97	32	32.7	70.73	-0.11
4/1/97 through 3/31/98	28	43.6	76.27	0.13
4/1/98 through 3/31/99	29	19.7	48.88	-0.40
4/1/99 through 3/31/00	9	37.8	62.80	0.00
4/1/00 through 3/31/01	17	182.9	225.47	3.20

Table 33 shows the current **1002** severity for the monitored result parameter for each lab for all operationally valid tests reported for the report period.

TABLE 33
TMC 1002

	n	Foam Tendency Mean Δ/s	Foam Stability Mean Δ/s
Lab A	4	5.35	7.21
Lab B	4	-0.78	-0.72
Lab D	3	0.90	1.81
Lab G	3	4.02	5.85
Lab I	2	-1.07	-0.83
Lab V	1	-6.31	7.10

D6082: High Temperature Foaming Characteristics of Lubricating Oils, continued

TMC 1007 INDUSTRY PERFORMANCE

Tables 34 and 35 show the current industry precision and severity for the Foam Tendency, Foam Stability and Total Volume Increase test parameter for all operationally valid tests **on oil 1007** for the report period. (First calibration test on TMC 1007 completed 4/12/99.)

TABLE 34

1007 Foam Tendency, ml	n	Mean	s_R	Mean Δ/s
Initial Round Robin Study (targets)	28	65.71	19.28	-----
4/12/99 through 3/31/00	17	65.3	18.41	-0.02
4/1/00 through 3/31/01	14	67.5	11.22	0.09

TABLE 35

1007 Foam Stability @ 1 min., ml	n	Mean	s_R
Initial Round Robin Study	28	0.00	0.00
4/12/99 through 3/31/00	17	No non-zero occurrences	
4/1/00 through 3/31/01	17	No non-zero occurrences	

Table 36 shows the current **1007** severity for the monitored result parameter for each lab for all operationally valid tests reported for the report period.

TABLE 36
TMC 1007

	n	Foam Tendency Mean Δ/s
Lab A	3	0.74
Lab B	5	-0.40
Lab D	1	-0.04
Lab G	3	0.40
Lab I	2	-0.04

D6082: High Temperature Foaming Characteristics of Lubricating Oils, continued

PRECISION AND SEVERITY

Foam Tendency precision is exceptionally poor for oil 1002 and significantly better for oil 1007 (s_R, Tables 31 and 34). Foam Tendency is significantly severe of target, and severe compared to previous periods, for oil 1002 and only slightly severe for oil 1007. Foam Tendency severity trends are graphically represented in Figures 8 and 9 (attached).

Foam Stability precision is also exceptionally worse for oil 1002 this period, and severity is exceptionally severe of target. Foam Stability severity and precision comparisons are difficult to estimate for oil 1007 due to the target mean and precision both having values of zero ml. There were no non-zero Foam Stability occurrences this period for 1007, indicating on target performance for this oil. Foam Stability severity for 1002 only is graphically represented in Figure 10 (attached). (Foam Stability results on oil 1002 are often the lower limit of zero ml. This phenomena accounts for the unusual "stair-like" mild trends observed in the 1002 Foam Stability CUSUM plot.)

Precision and severity on oil 1007 looks very good this period, with substantially improved precision and only slightly severe performance for Foam Tendency (Foam Stability performed as expected with no non-zero occurrences). However, precision and severity on oil 1002 seems to be a very serious problem this period. Precision on 1002 worsened alarmingly while severity shifted from moderately mild in previous periods to near target last period, then suddenly and substantially severe this period. There were seven foam tendency results from four labs this period greater than 2 s from target (3.9, 4.1, 3.7, -6.3, 8.0, 8.0 & 7.8 s; it is interesting to note that one of the results is significantly mild while the other six are severe). For Foam Stability, the same seven tests on oil 1002 are also more than 2 s from target (6.7, 5.3, 3.8, 7.1, 12.4, 11.7, 11.5 s). No explanations for the extreme results were indicated by the reporting laboratories, and the results are far too numerous to be excluded as rare events. The overall percentage of operationally valid tests which failed to meet the acceptance criteria for oil 1002 is very high this period.

Over the last few months, the TMC has been talking with the labs about the source of the severity problems with oil 1002. It might be that the oil itself is changing in performance, though there is no direct evidence that this is the case. (The stable, or even improved, performance of calibration tests on 1007 is suggestive of a possible problem with oil 1002, though oil 1007 does not perform nearly as severe as does oil 1002.) The TMC had been supplying reference oil samples of 1002 out of a single drum dedicated to D6082 calibration testing. The oil in this drum was mixed each time D6082 calibration aliquots were poured at the TMC. That dedicated drum is now about 2/3 empty. Because of the observed severity shift, the TMC recently decided to discontinue pouring from the initial dedicated drum, and has begun to pour D6082 reference oil samples from a different, full drum of 1002 which is now dedicated to that purpose. Two labs volunteered to run screener tests on samples taken from the new, dedicated drum. The results of those screener tests were within the acceptance range. The details of this investigation, and the TMC's actions to resolve the problem, are summarized in a memo issued by the TMC's Tom Schofield: TMC Memo 01-124; March 16, 2001; D6082 TMC Calibration Severity Special Report. That memo was distributed to the participants and interested parties by e-mail on March 16, 2000.

Only time will tell if the TMC's actions will help to stabilize the calibration performance of TMC oil 1002. However, after discussions with some of the laboratories, it may also be that the labs will need to take extra care in handling severely performing oils like 1002. Being sure to agitate the sample in its

original container before pouring it, and not allowing the samples to sit excessively long after blending (option A) may also help to stabilize the observed performance problems.

TMC MEMORANDA

There were two TMC technical memoranda issued this report period for the D6082 test method:

Memo 00-136, October 10, 2000, D6082 Report Package Upgrade
Memo 01-024, March 16, 2001, D6082 TMC Calibration Severity Special Report

D6557: Ball Rust Test (BRT)

Note that due to the large testing volume, the report period for this test consists of the six-month period from October 1, 2000 through March 31, 2001. Also note that, for BRT, a positive Δ/s is mild, not severe (a higher AGV result is considered to be a more mild result while a lower AGV result is considered to be a more severe result.)

STATUS

Table 37 summarizes the reference tests reported to the TMC this period (3 labs reporting):

TABLE 37

	No. of Tests
Statistically Acceptable and Operationally Valid	107
Operationally Valid but Failed Acceptance Criteria	5
Operationally Invalid	1
Total	**113**

Fail Rate of Operationally Valid Tests: 4.5%

Table 38 is a breakdown of the statistically unacceptable tests.

TABLE 38

Reason for Fail	No. of Tests
Average AGV Mild	3
Average AGV Severe	2

INDUSTRY PERFORMANCE

Table 39 shows the current Industry precision and severity for the Average AGV test parameter for all operationally valid tests for the report period. (First calibration test completed 8/15/00.)

TABLE 39

Average AGV	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study (targets)	48	44	9.43	-----
8/15/00 through 9/30/00	28	25	10.50	0.38
10/1/00 through 3/31/01	112	109	8.48	0.42

Table 40 shows the current severity for the Average AGV parameter for each lab for all operationally valid tests for the report period.

TABLE 40

	n	Mean Δ/s
Lab A	60	0.52
Lab B	41	0.22
Lab G	9	0.19
Lab D	2	2.30

D6557: Ball Rust Test (BRT), continued

PRECISION AND SEVERITY

Precision this report period compares well with both the previous period and the target matrix. Overall severity is trending mild of target with Lab D trending significantly mild. Severity is graphically represented in Figure 11 (attached).

TMC MEMORANDA

There was one technical memorandum issued this report period: Memo 00-177, November 28, 2000, was issued to advise the panel that Test Method D6557-00, Evaluation of Rust Preventive Characteristics of Automotive Engine Oils, is now available from ASTM Headquarters.

Engine Oil Filterability Test (EOFT)

Note that because of the large testing volume the report period for the EOFT will cover six months, from October 1, 2000 through March 31, 2001. Also note that, for EOFT, a positive Δ/s is mild, not severe (a more positive CIF result is considered to be a more mild result while a more negative CIF result is considered to be a more severe result.)

STATUS

Table 41 summarizes the reference tests reported to the TMC this period (3 labs reporting):
Note that due to reference volume, the report period is from October 1, 2000 through March 31, 2001.

TABLE 41

	No. of Tests
Statistically Acceptable and Operationally Valid	74
Operationally Valid but Failed Acceptance Criteria	5
Operationally Invalid	2
Total	**81**

Fail Rate of Operationally Valid Tests: 6.3%

Table 42 is a breakdown of the statistically unacceptable tests.

TABLE 42

Reason for Fail	No. of Tests
Average % Change in Flow Mild (Oil 77)	5
Average % Change in Flow Mild (Oil 78)	0

INDUSTRY PERFORMANCE

Table 43 shows the current Industry precision and severity for the Average % Change in Flow (CIF) test parameter for all operationally valid tests for the report period. (First calibration test completed 5/4/00.)

TABLE 43

Average % CIF	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study (targets)	24	22	5.76	-----
5/4/00 through 9/30/00	53	51	7.47	1.64
10/1/00 through 3/31/01	79	78	4.79	0.30

Table 44 shows the current severity for the Average % CIF parameter for each lab for all operationally valid tests for the report period.

TABLE 44

	n	Mean Δ/s
Lab A	25	0.24
Lab B	26	0.56
Lab G	28	0.12

PRECISION AND SEVERITY

Precision this report period is directionally better than the previous period and the target matrix. Overall severity is trending mild of target. Labs A is and B are trending mild, while Lab G is on or near target. Severity is graphically represented in Figure 12 (attached).

All labs have had problems passing on TMC Oil 77. During the period, the Surveillance Panel agreed to suspend the use of TMC 77. It should be noted that the five failing results were on TMC 77. No failing results were reported on TMC 78. Table 45 compares the statistics for both reference oils reported during this report period with the Target Matrix results.

Table 45
EOFT 20 – 25 ml Average % Change in Flowrate

	TMC Oil 77							TMC Oil 78						
	Calibration Data				Target Matrix			Calibration Data				Target Matrix		
Lab	n	Mean	s	Δ/s	n	Mean	s	n	Mean	s	Δ/s	n	Mean	s
A	2	-18.5	6.78	6.21	3	-43.88	---	23	13.8	4.31	-0.28	3	13.21	---
B	2	-13.8	2.82	7.31	3	-49.54	---	24	15.8	3.20	0.00	3	23.19	---
G	1	-28.4	---	3.95	3	-47.67	---	27	15.6	5.79	-0.03	3	8.33	---
Overall	5	-18.5	7.03	6.20	12	-45.55	4.36	74	15.09	4.64	-0.10	12	15.74	6.87

Note: Target Matrix overall n size of 12 includes one lab which contributed matrix data but does not calibrate with the TMC; for brevity, this lab is not listed in the table but their matrix results are factored into the overall statistics.

Presently, no participating lab can pass on Oil 77. Because of this the Engine Oil Filterability Surveillance Panel has voted to suspend the use of TMC 77 for calibration while the Surveillance Panel investigates the problem. Performance with reference oil TMC 78 was on or near target for labs B and G, while lab A was slightly severe. Precision in all three labs with TMC 78 compares well with the test target matrix precision. At this time, only TMC 78 is being assigned as a TMC calibration oil. Because of this, we do not have a truly blind referencing system at the present time.

TMC MEMORANDA

There were no technical memoranda issued this report period nor were there any information letters issued this report period.

Engine Oil Water Tolerance Test (EOWT)

Note that because of the large testing volume the report period for the EOFT will cover six months, from October 1, 2000 through March 31, 2001. Also note that, for EOWT, a positive Δ/s is mild, not severe (a more positive CIF result is considered to be a more mild result while a more negative CIF result is considered to be a more severe result).

Engine Oil Water Tolerance Test (EOWT): 0.6% Water Treat Level

STATUS

Table 46 summarizes the reference tests reported to the TMC this period (3 labs reporting):

TABLE 46

	No. of Tests
Statistically Acceptable and Operationally Valid	99
Operationally Valid but Failed Acceptance Criteria	2
Operationally Invalid	0
Total	**101**

Fail Rate of Operationally Valid Tests: 2.0%

Table 47 is a breakdown of the statistically unacceptable tests.

TABLE 47

Reason for Fail	No. of Tests
Average % Change in Flow Severe (Oil 78)	2

INDUSTRY PERFORMANCE

Table 48 shows the current Industry precision and severity for the Average % Change in Flow (CIF) test parameter for all operationally valid tests for the report period. (First calibration test completed 5/4/00.)

TABLE 48

Average % CIF	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study (targets)	24	22	5.93	-----
5/4/00 through 9/30/00	34	32	6.25	-0.039
10/1/00 through 3/31/01	101	99	5.61	-0.173

Table 49 shows the current severity for the Average % CIF parameter for each lab for all operationally valid tests for the report period.

TABLE 49

	n	Mean Δ/s
Lab A	27	-0.84
Lab B	46	-0.33
Lab G	28	0.73

PRECISION AND SEVERITY

Precision is directionally better than target, and severity is trending severe. Severity is graphically represented in Figure 13 (attached). Lab G is trending mild, while labs A and B are trending severe.

Engine Oil Water Tolerance Test (EOWT): 1.0% Water Treat Level

STATUS

Table 50 summarizes the reference tests reported to the TMC this period (3 labs reporting):

TABLE 50

	No. of Tests
Statistically Acceptable and Operationally Valid	94
Operationally Valid but Failed Acceptance Criteria	5
Aborted	1
Operationally Invalid	1
Total	**101**

Fail Rate of Operationally Valid Tests: 5.1%

Table 51 is a breakdown of the statistically unacceptable tests.

TABLE 51

Reason for Fail	No. of Tests
Average % Change in Flow Severe (Oil 77)	1
Average % Change in Flow Mild (Oil 77)	1
Average % Change in Flow Severe (Oil 78)	3

INDUSTRY PERFORMANCE

Table 52 shows the current Industry precision and severity for the Average % Change in Flow (CIF) test parameter for all operationally valid tests for the report period. (First calibration test completed 5/4/00.)

TABLE 52

Average % CIF	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study (targets)	24	22	5.81	-----
5/4/00 through 9/30/00	33	31	6.98	0.12
10/1/00 through 3/31/01	99	97	5.85	-0.19

Table 53 shows the current severity for the Average % CIF parameter for each lab for all operationally valid tests for the report period.

TABLE 53

	n	Mean Δ/s
Lab A	26	-0.54
Lab B	45	-0.65
Lab G	28	0.88

PRECISION AND SEVERITY

Precision is directionally better than the previous period and compares well with historical rates. Industry data is trending slightly severe. Lab G is trending mild, while Labs A and B are trending severe. Severity is graphically represented in Figure 14 (attached).

Engine Oil Water Tolerance Test (EOWT): 2.0% Water Treat Level

STATUS

Table 54 summarizes the reference tests reported to the TMC this period (3 labs reporting):

TABLE 54

	No. of Tests
Statistically Acceptable and Operationally Valid	98
Operationally Valid but Failed Acceptance Criteria	2
Operationally Invalid	1
Total	**101**

Fail Rate of Operationally Valid Tests: 2.0%

Table 55 is a breakdown of the statistically unacceptable tests.

TABLE 55

Reason for Fail	No. of Tests
Average % Change in Flow Mild (Oil 78)	1
Average % Change in Flow Mild (Oil 78)	1

INDUSTRY PERFORMANCE

Table 56 shows the current Industry precision and severity for the Average % Change in Flow (CIF) test parameter for all operationally valid tests for the report period. (First calibration test completed 5/4/00.)

TABLE 56

Average % CIF	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study (targets)	24	22	7.08	-----
5/4/00 through 9/30/00	31	29	5.63	-0.07
10/1/00 through 3/31/01	100	98	6.25	-0.16

Table 57 shows the current severity for the Average % CIF parameter for each lab for all operationally valid tests for the report period.

TABLE 57

	n	Mean Δ/s
Lab A	26	-0.39
Lab B	46	-0.67
Lab G	28	0.88

PRECISION AND SEVERITY

Precision is comparable to the previous period and historical estimates this period and severity is trending slightly severe of target (severe bias). Again Lab G is running mild, while labs A and B are running severe. Severity is graphically represented in Figure 15 (attached).

Engine Oil Water Tolerance Test (EOWT): 3.0% Water Treat Level

STATUS

Table 58 summarizes the reference tests reported to the TMC this period (3 labs reporting):

TABLE 58

	No. of Tests
Statistically Acceptable and Operationally Valid	96
Operationally Valid but Failed Acceptance Criteria	2
Operationally Invalid	1
Total	**99**

Fail Rate of Operationally Valid Tests: 2.0%

Table 59 is a breakdown of the statistically unacceptable tests.

TABLE 59

Reason for Fail	No. of Tests
Average % Change in Flow Mild (Oil 78)	1
Average % Change in Flow Severe (Oil 78)	1

INDUSTRY PERFORMANCE

Table 60 shows the current Industry precision and severity for the Average % Change in Flow (CIF) test parameter for all operationally valid tests for the report period. (First calibration test completed 5/4/00.)

TABLE 60

Average % CIF	n	df	Pooled s	Mean Δ/s
Initial Round Robin Study (targets)	24	22	5.79	-----
5/4/00 through 9/30/00	32	30	5.71	0.23
10/1/00 through 3/31/01	98	96	5.71	-0.01

Table 61 shows the current severity for the Average % CIF parameter for each lab for all operationally valid tests for the report period.

TABLE 61

	n	Mean Δ/s
Lab A	24	-0.46
Lab B	46	-0.53
Lab G	28	1.23

PRECISION AND SEVERITY

Precision is comparable to target and calibrations are on target for severity. Severity is graphically represented in Figure 16 (attached). Laboratory G is trending mild while labs A and B are trending severe. This laboratory bias has been consistent throughout all treat levels.

REFERENCE OIL SUPPLIES

There is adequate supply of PCEOCP Bench Test reference oils on hand at the TMC. Table 62 lists the PCEOCP bench test reference oils currently on hand at the TMC.

Table 62

Oil	For Tests	Quantity Left (gallons)	Quantity Used Last 12 Months (gallons)
5A-3	BRT	1788.2	0.5
51	VGC, EVLO, GI	94.6	0.1
52	VGC, EVLO, GI	89.2	0.7
53	VGC, EVLO, GI	97.2	0.2
54	VGC, EVLO	97.8	0.1
55	VGC, EVLO, GI	93.8	0.8
^56	VGC, EVLO	51.2	0.0
^57	VGC, EVLO	51.2	0.0
58	VGC, EVLO	147.2	1.3
62	GI	16.3	0.1
71	TEOST	5.9	0.3
72	TEOST	5.0	0.3
74	MTEOS	2.8	0.2
77	EOFT, EOWT	233.4	32.0
78	EOFT, EOWT	225.4	34.3
^80	BRT	26.5	0.0
81	BRT	21.8	0.8
**432	MTEOS	Adequate	-----
**433	MTEOS	Adequate	-----
*1002	FOAM	53.0	-----
*1006	BRT, MTEOS	55.0	-----
*1007	FOAM	18.4	-----

^Not selected as reference oil; TMC holding for further instructions from Surveillance Panel.
*One drum of oil is set aside for bench calibration testing; the TMC has a larger supply of this oil.
**Five gallon aliquot set aside for bench testing; hard to get an inventory reading on amount set aside.

REFERENCE OIL SUPPLIES, continued

Shipping aliquots are:

VGC	1 or 4 ml
EVLO	100 ml
GI	25 ml
MTEOS	17 ml
TEOST	125 ml
FOAM	525 ml
EOFT	290 ml
EOWT	290 ml
BRT	30 ml

MISCELLANEOUS

The TMC posts monitored bench test calibration data on the Internet. Selected parameters from all operationally valid reference tests are posted on the TMC's World-Wide-Web page in real time (that is, as the tests are reported to the TMC, and a validity designation is assigned). Lab identifications are coded as they are on the previous pages of this report. Also posted are statistics, CUSUM plots, reporting forms and data dictionaries and data from various matrix programs (like GF-3 test development and reference oil selection matrix programs). The TMC encourages all interested parties to access and download the data, statistics and plots for individual studies and analyses. Likewise, you are encouraged to access the web site to download the most recent test reporting forms and data dictionaries. The TMC's web site address is http://www.tmc.astm.cmri.cmu.edu.

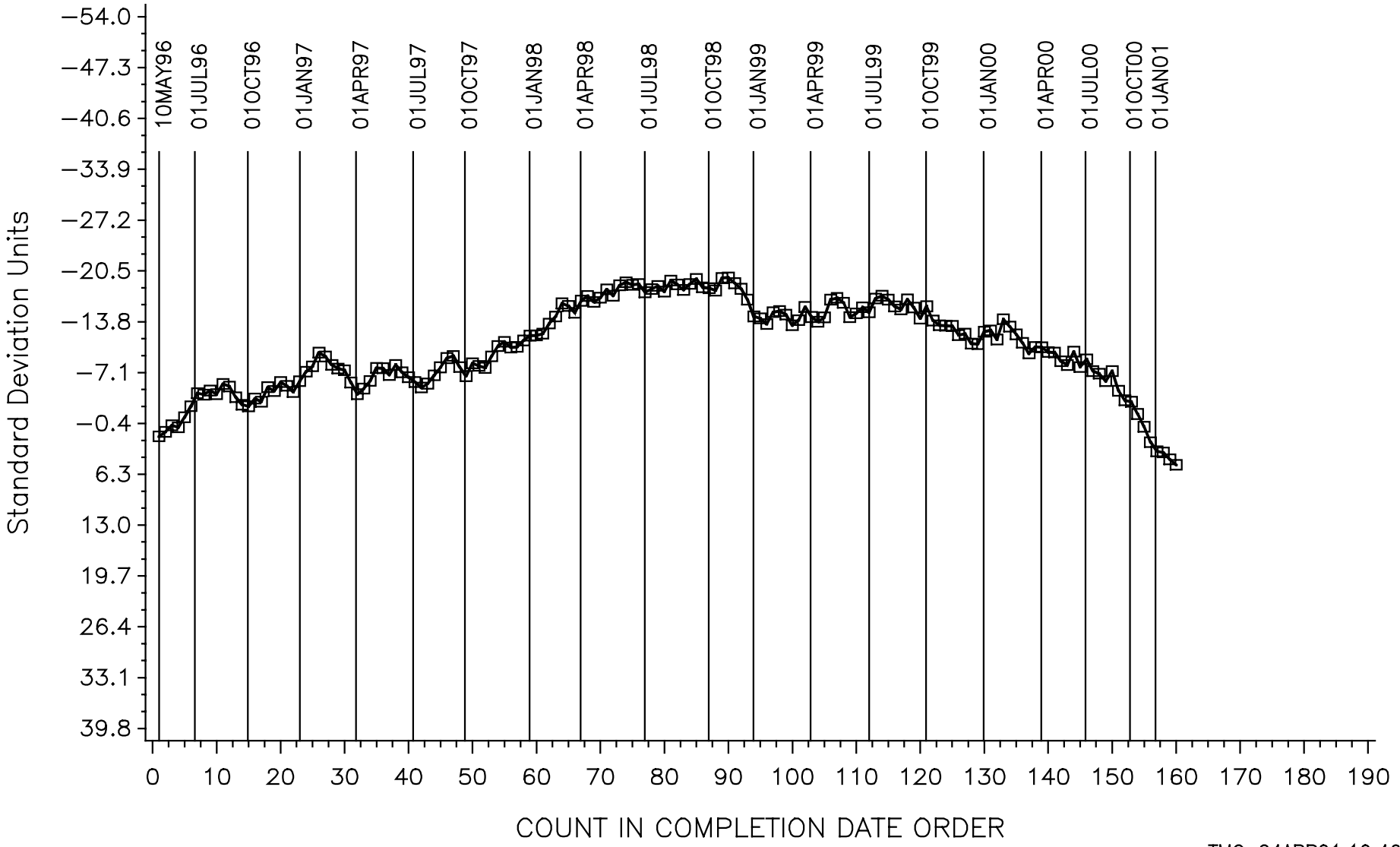
All currently monitored bench test data dictionaries and report form packages have been beta tested and approved by the Data Communications Committee (DCC) for electronic data transfer. TMC Memo 98-210 (September 16, 1998) was issued explaining the TMC's electronic data transmission protocols. In that memo, the TMC strongly encourages participating laboratories to use electronic data transfer for reporting reference test data to the TMC. If your lab should require additional information on this type of data reporting, please contact Tom Schofield at (412) 365-1011 or Rich Grundza at (412) 365-1031.

VGC-D2887 EXTENDED INDUSTRY OPERATIONALLY VALID DATA

Figure 1

SAMPLE AREA % VOLATIZED @ 371'C ... 700'F (AREA %)

CUSUM Severity Analysis



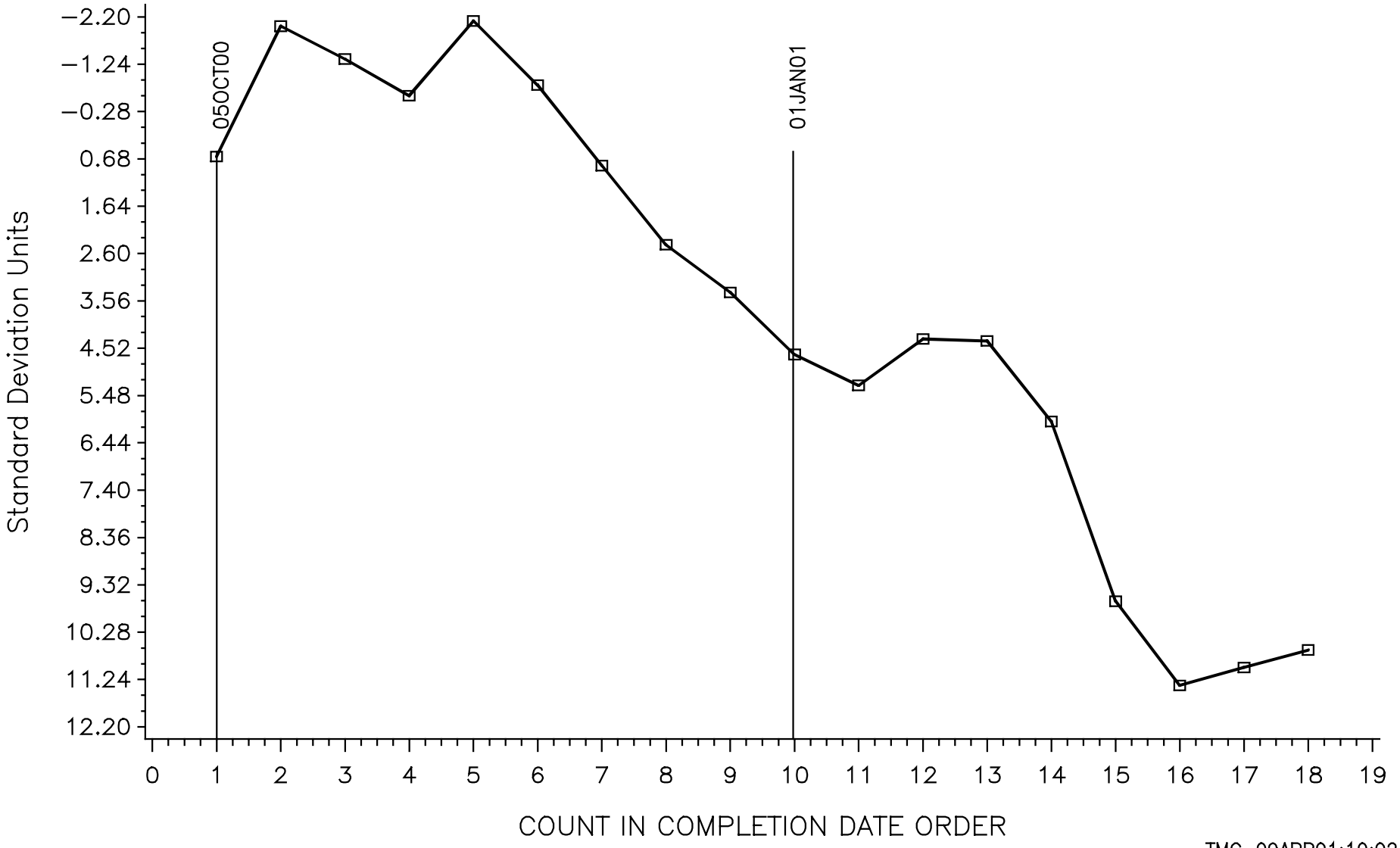
TMC 24APR01:10:46

D6417 INDUSTRY OPERATIONALLY VALID DATA

Figure 2

SAMPLE AREA % VOLATIZED @ 371'C ... 700'F (Area %

CUSUM Severity Analysis



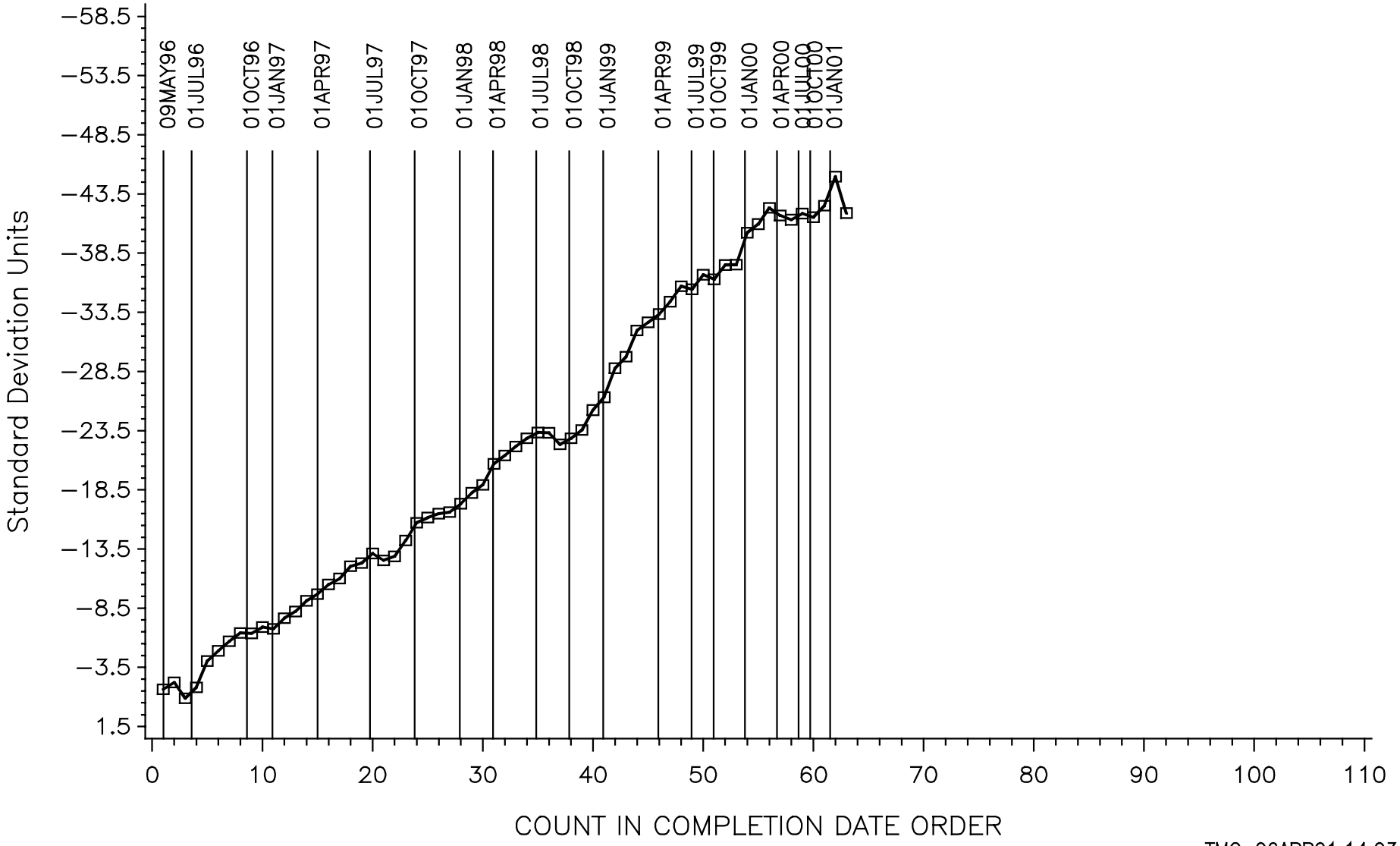
TMC 09APR01:10:02

VGC–D5480 INDUSTRY OPERATIONALLY VALID DATA

Figure 3A

SAMPLE MASS % VOLATIZED @ 371'C ... 700'F (MASS %)

CUSUM Severity Analysis



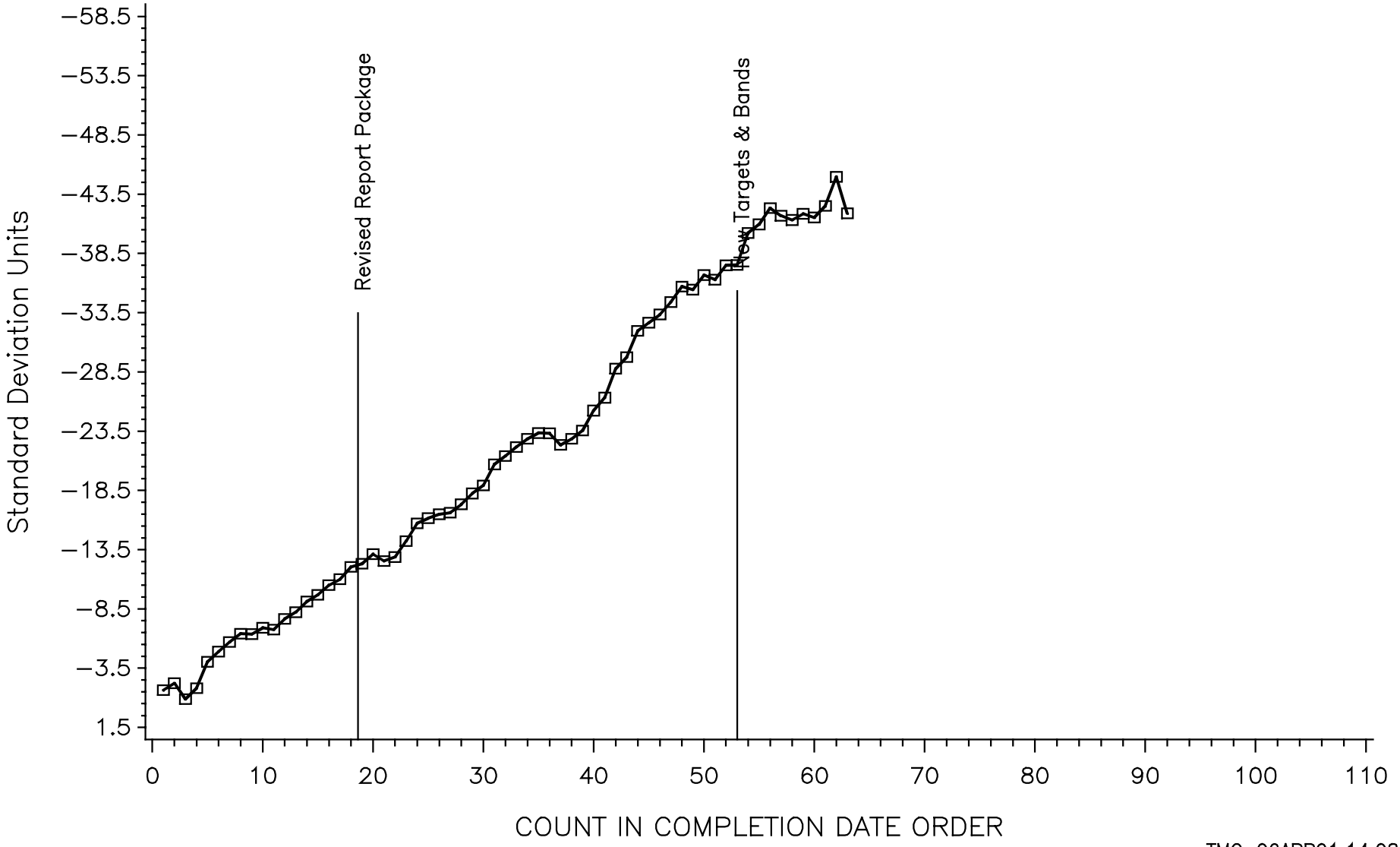
TMC 06APR01:14:03

VGC–D5480 INDUSTRY OPERATIONALLY VALID DATA

Figure 3B

SAMPLE MASS % VOLATIZED @ 371'C ... 700'F (MASS %)

CUSUM Severity Analysis



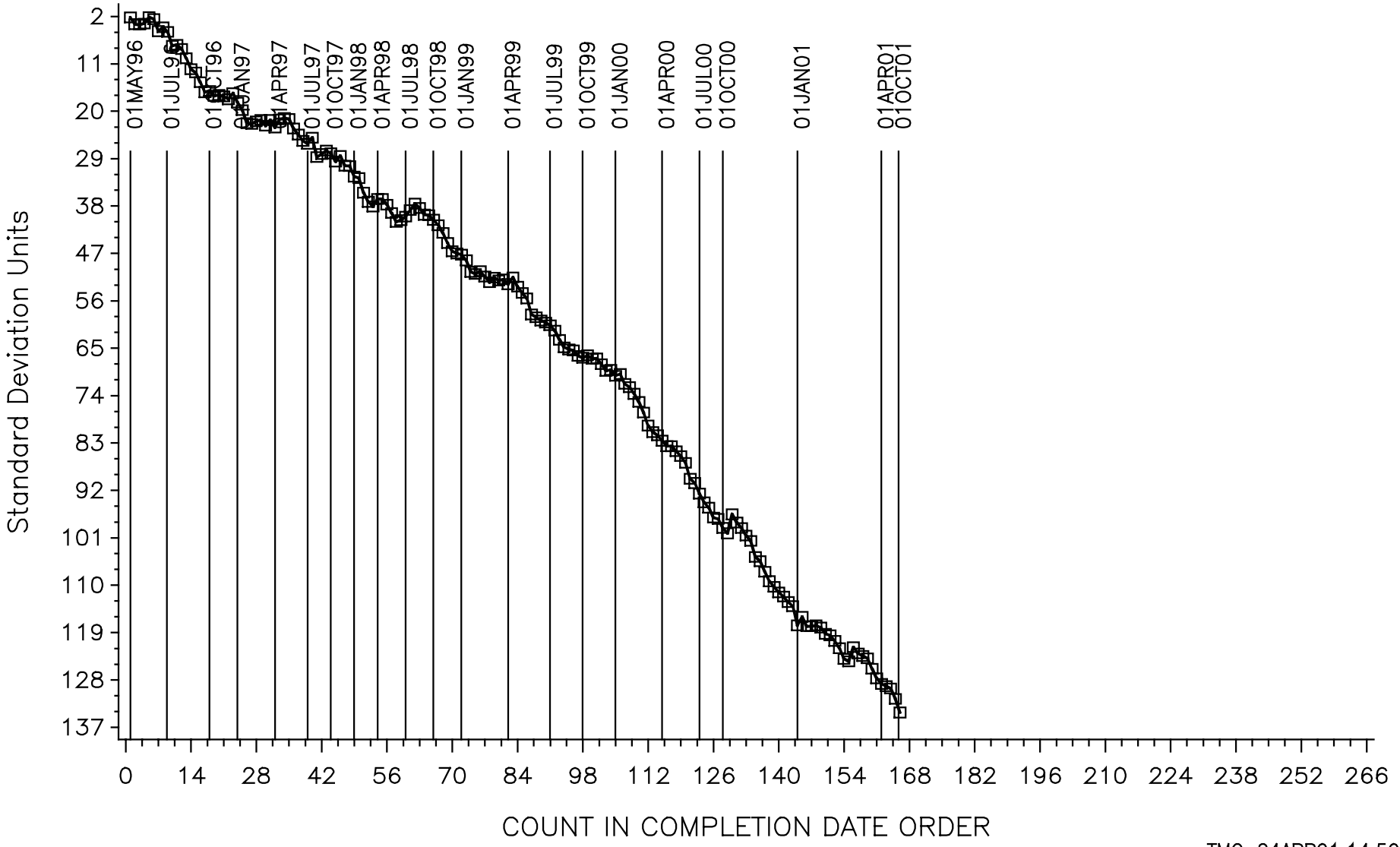
TMC 06APR01:14:08

D5800 INDUSTRY OPERATIONALLY VALID DATA

Figure 4A

TEST OIL SAMPLE EVAPORATION LOSS (MASS %)

CUSUM Severity Analysis



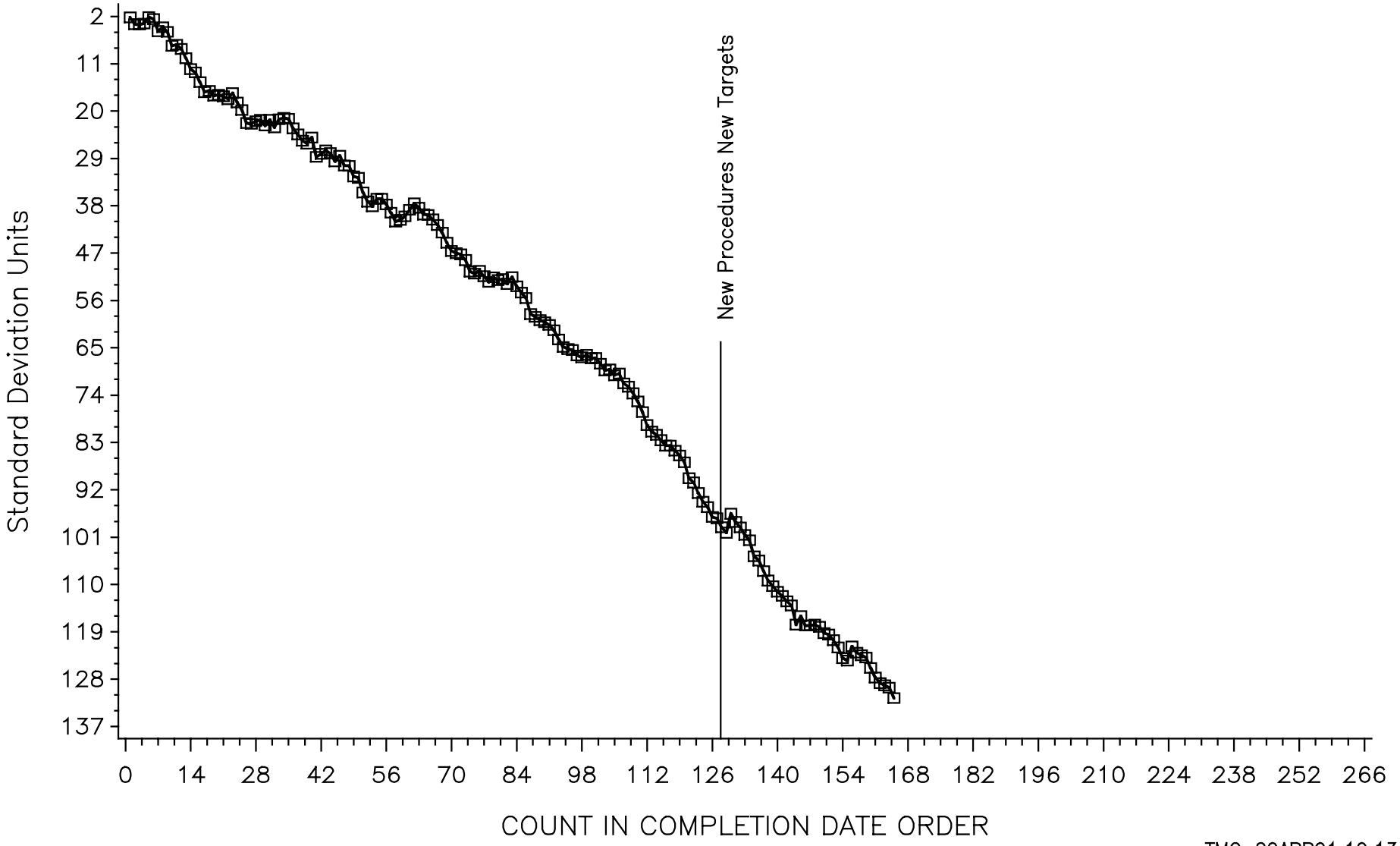
TMC 24APR01:14:50

D5800 INDUSTRY OPERATIONALLY VALID DATA

Figure 4B

TEST OIL SAMPLE EVAPORATION LOSS (MASS %)

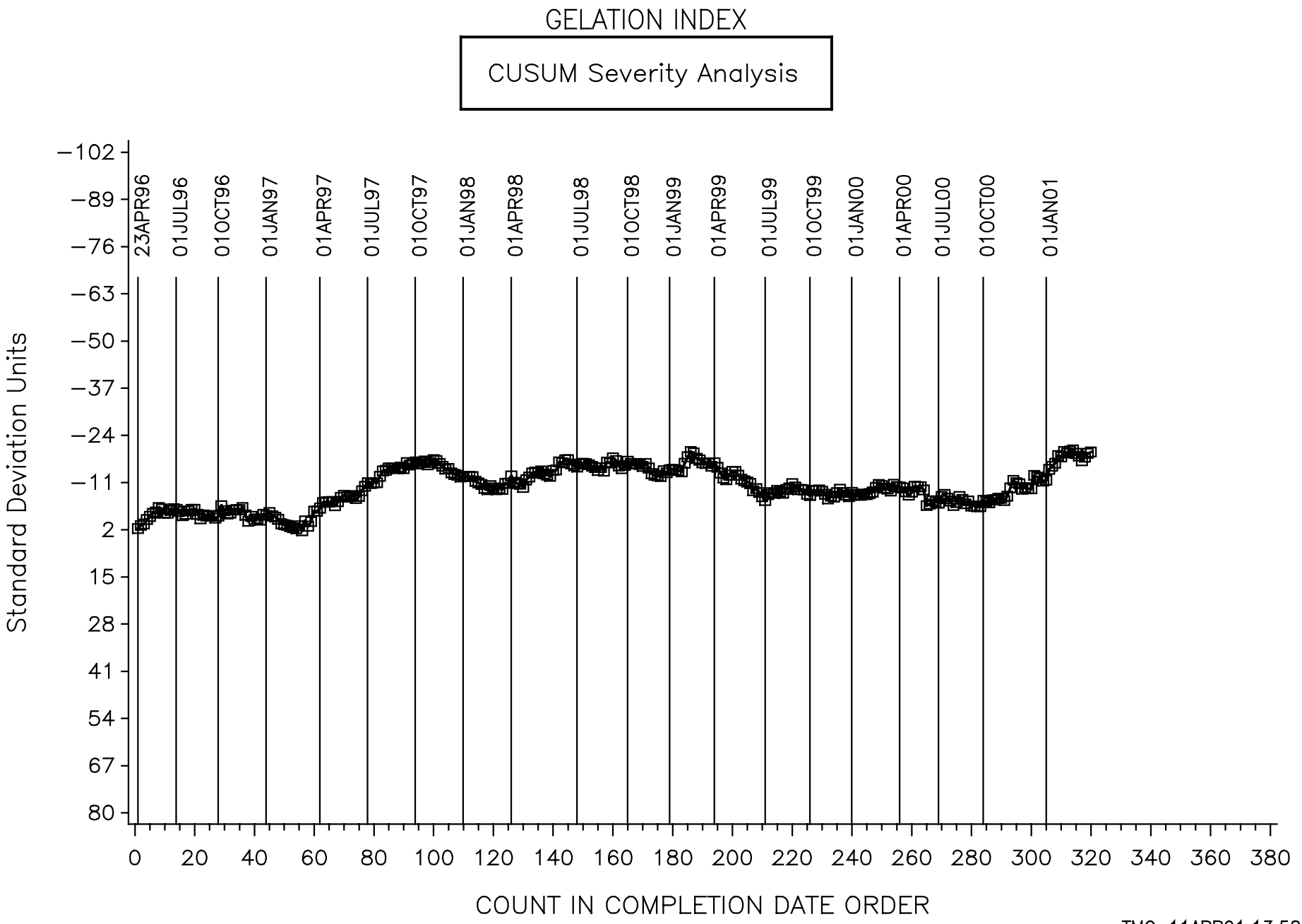
CUSUM Severity Analysis



TMC 20APR01:10:13

GELATION INDEX INDUSTRY OPERATIONALLY VALID DATA

Figure 5



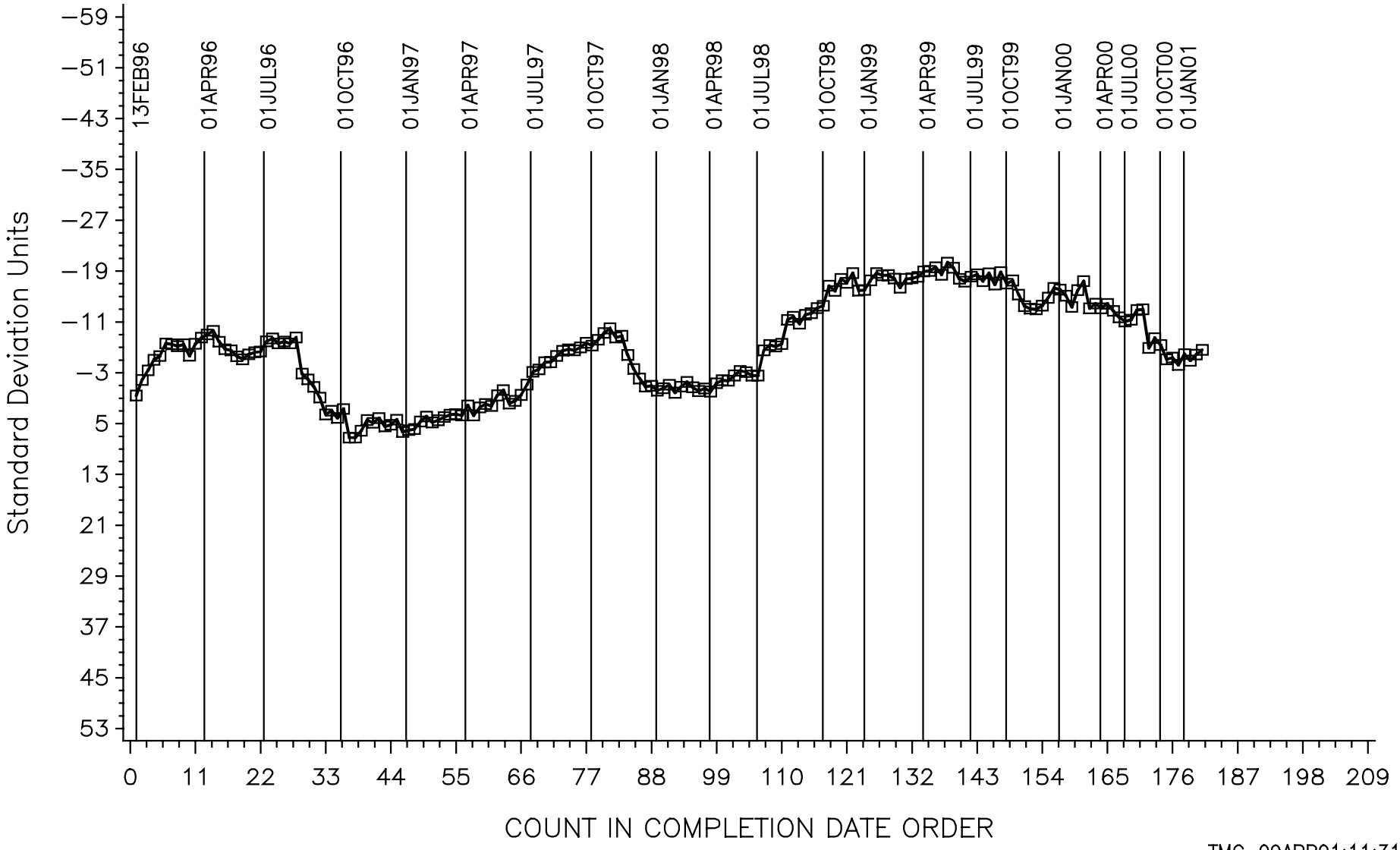
TMC 11APR01:13:58

TEOST INDUSTRY OPERATIONALLY VALID DATA

Figure 6

TOTAL DEPOSITS (mg)

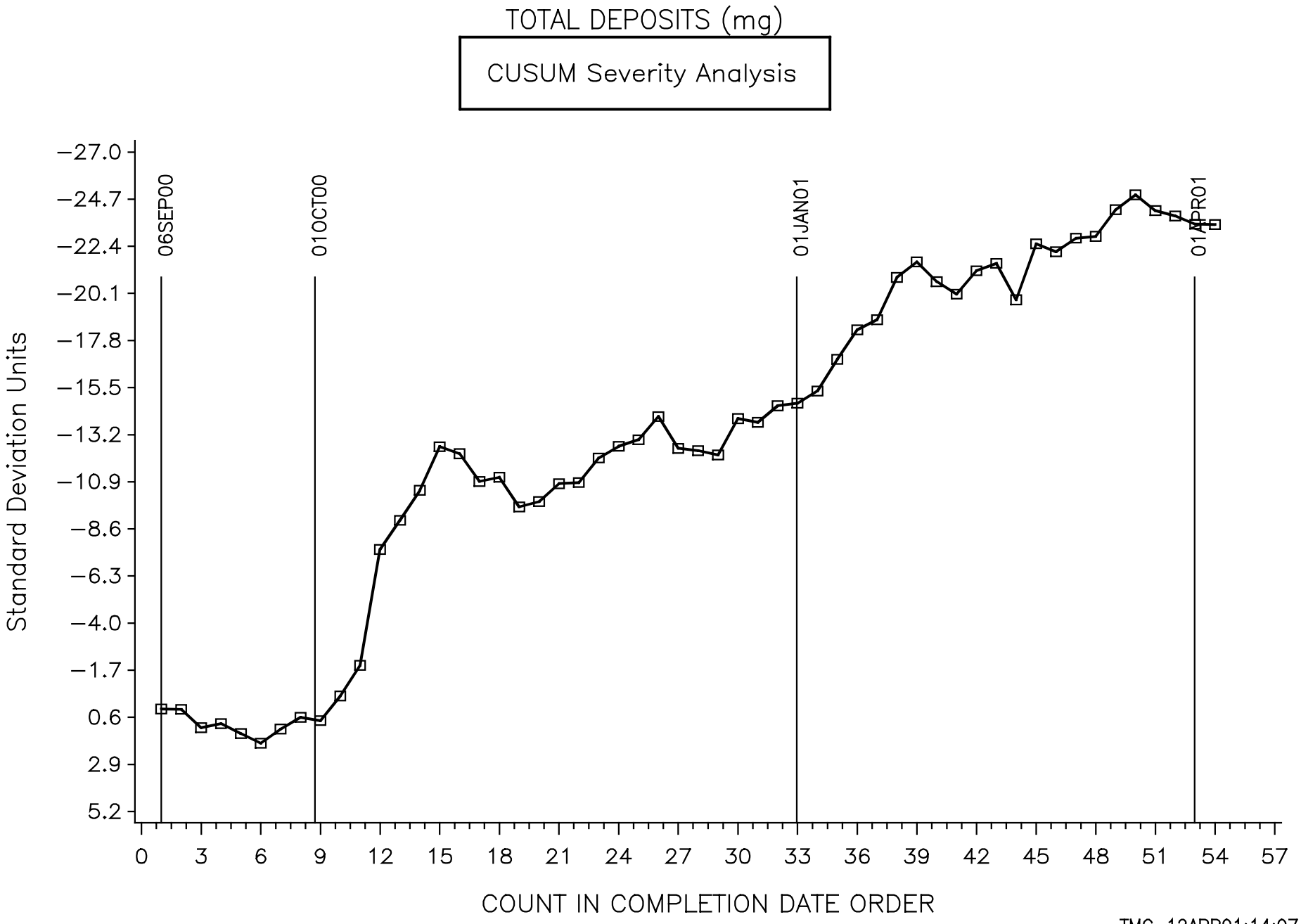
CUSUM Severity Analysis



TMC 09APR01:11:31

MHT TEOST INDUSTRY OPERATIONALLY VALID DATA

Figure 7



TMC 12APR01:14:07

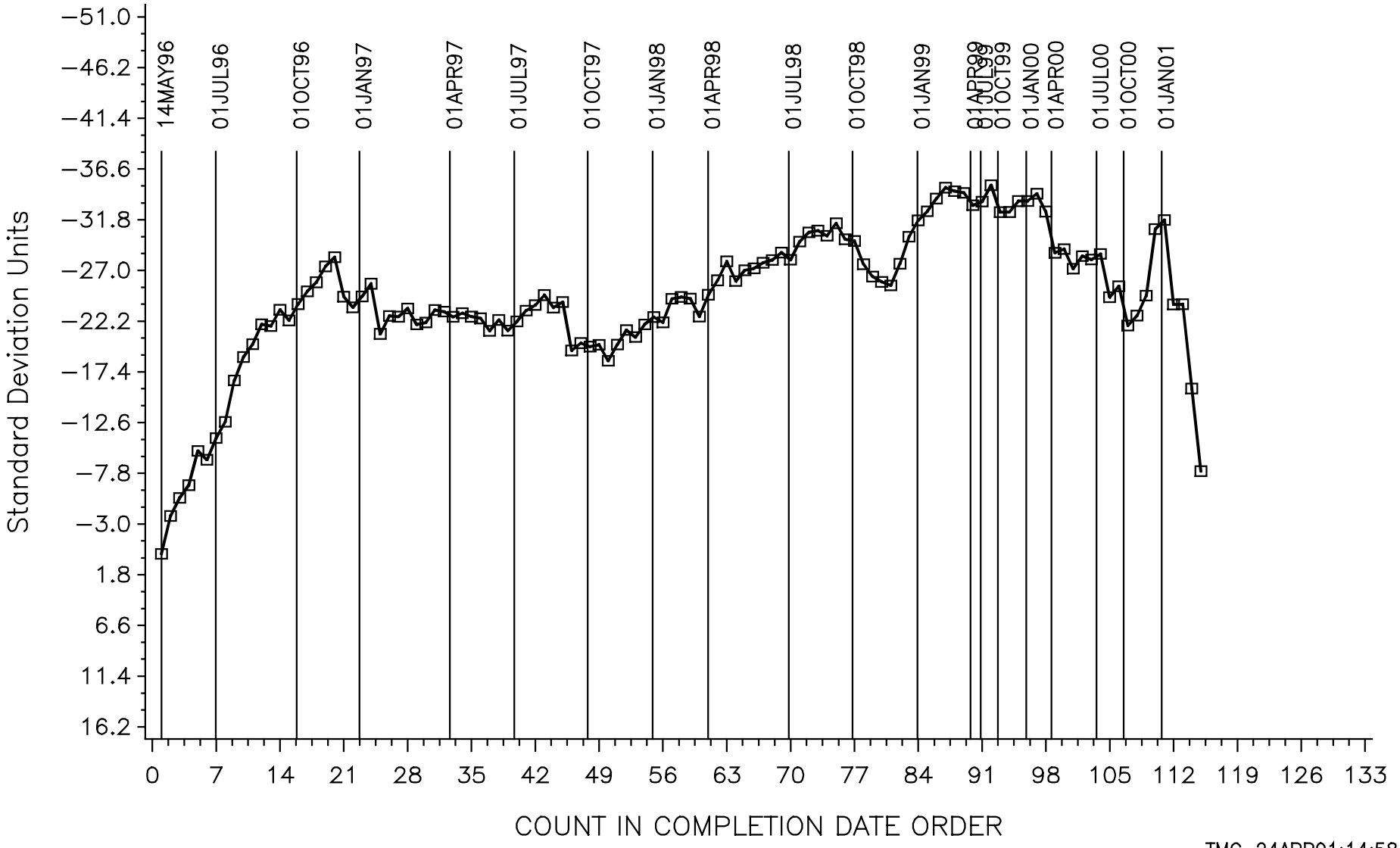
D6082 INDUSTRY OPERATIONALLY VALID DATA

TMC Oil 1002

FOAM TENDENCY, IMMEDIATELY BEFORE DISCONNECT STATI

Figure 8

CUSUM Severity Analysis



TMC 24APR01:14:58

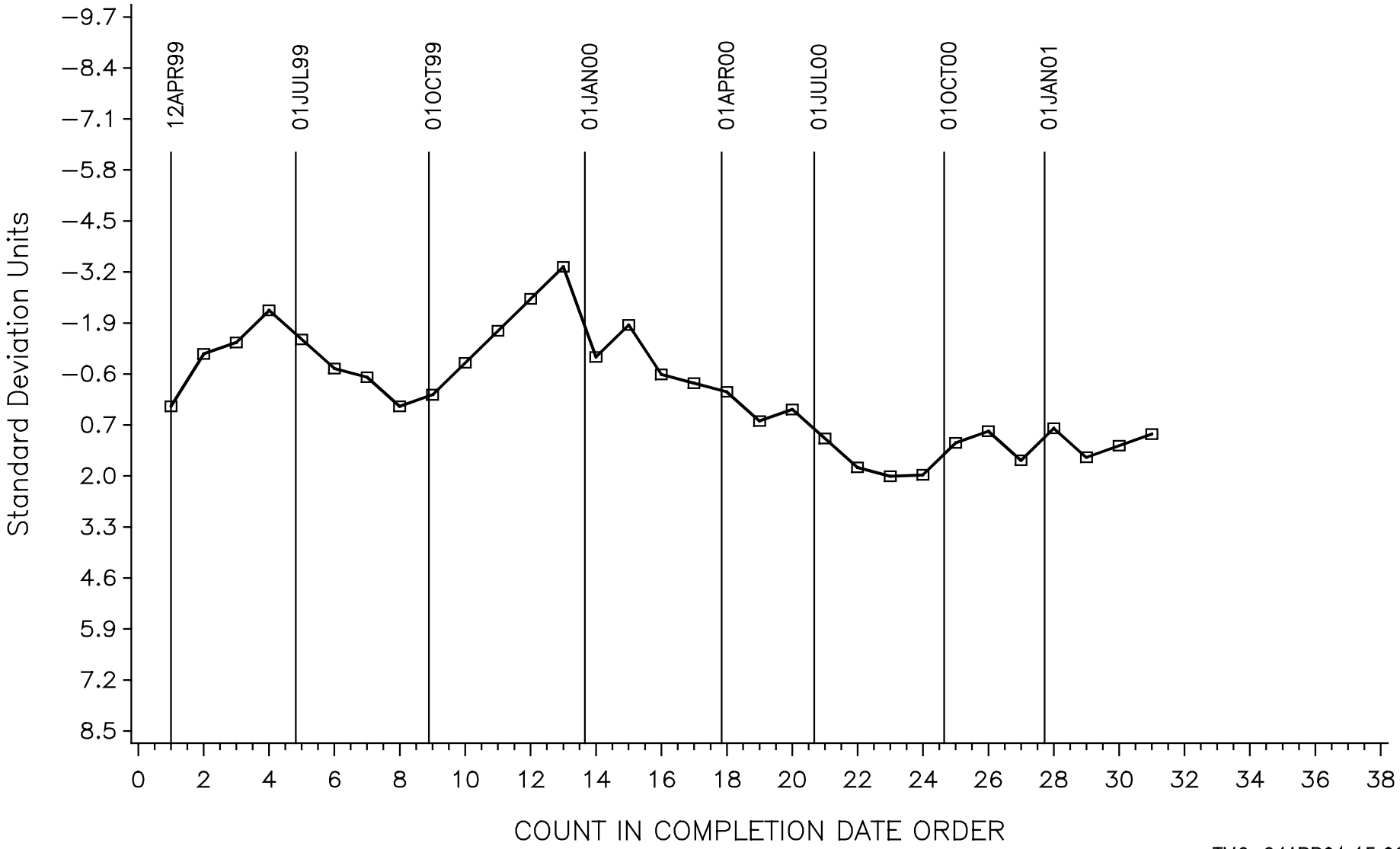
Figure 9

D6082 INDUSTRY OPERATIONALLY VALID DATA

TMC Oil 1007

FOAM TENDENCY, IMMEDIATELY BEFORE DISCONNECT STATI

CUSUM Severity Analysis



TMC 24APR01:15:02

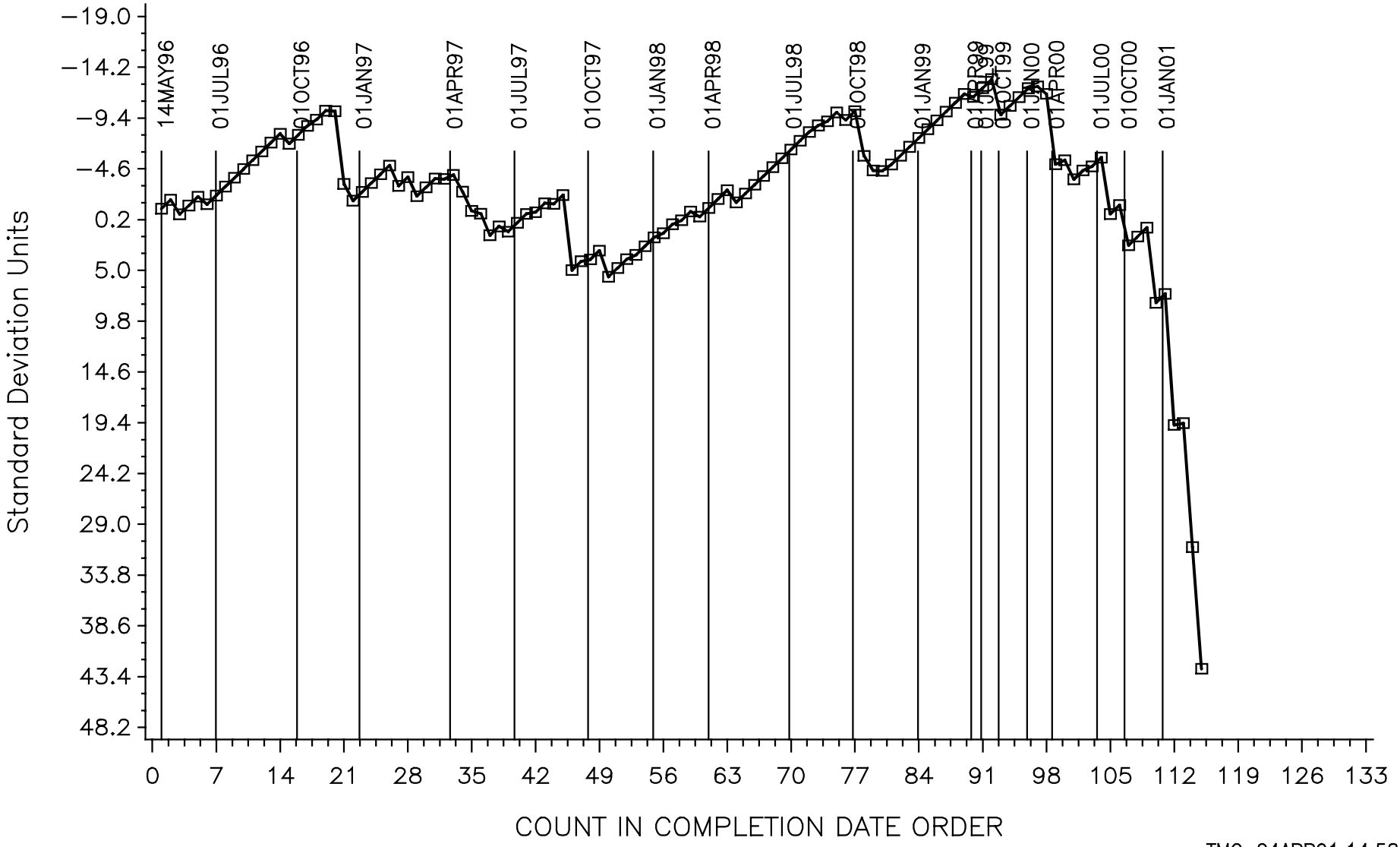
Figure 10

D6082 INDUSTRY OPERATIONALLY VALID DATA

TMC Oil 1002

FOAM STABILITY, 1 MINUTE AFTER DISCONNECT STATIC F

CUSUM Severity Analysis



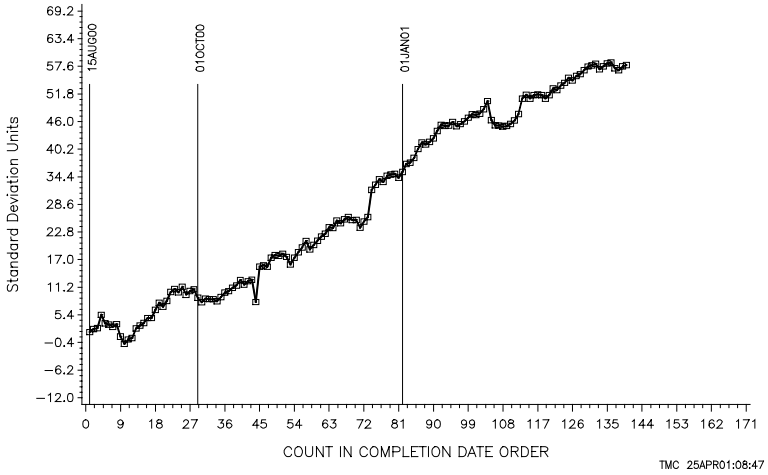
TMC 24APR01:14:58

BALL RUST TEST INDUSTRY OPERATIONALLY VALID DATA

Figure 11

REFERENCE AVERAGE GRAY VALUE AVERAGE

CUSUM Severity Analysis



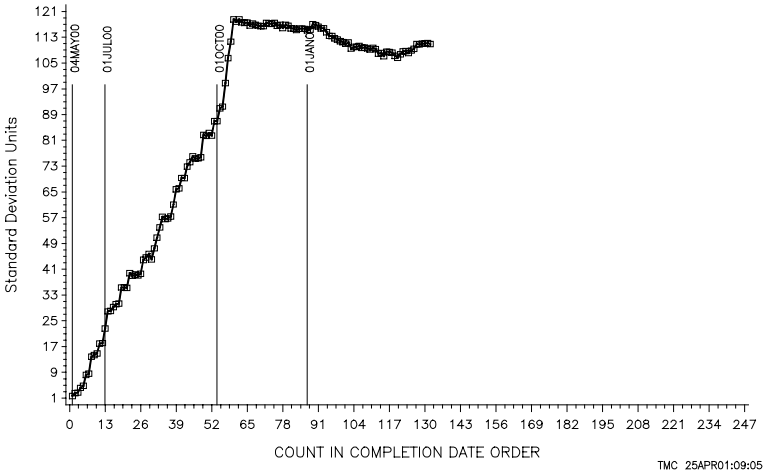
TMC 25APR01:08:47

EOFT INDUSTRY OPERATIONALLY VALID DATA

Figure 12

20 – 25 ML CHANGE IN FLOWRATE AVERAGE (%)

CUSUM Severity Analysis



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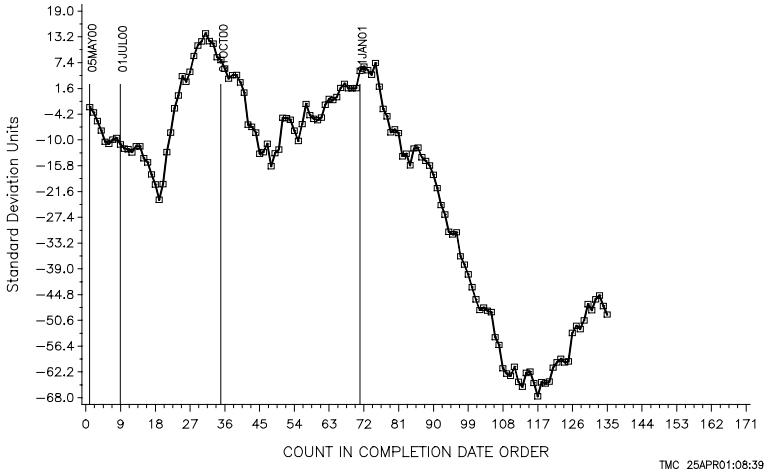
EOWT INDUSTRY OPERATIONALLY VALID DATA

Figure 13

0.6 % Water Treat Level

TEST RUN 20 – 25 ML CHANGE IN FLOWRATE AVERAGE (%)

CUSUM Severity Analysis



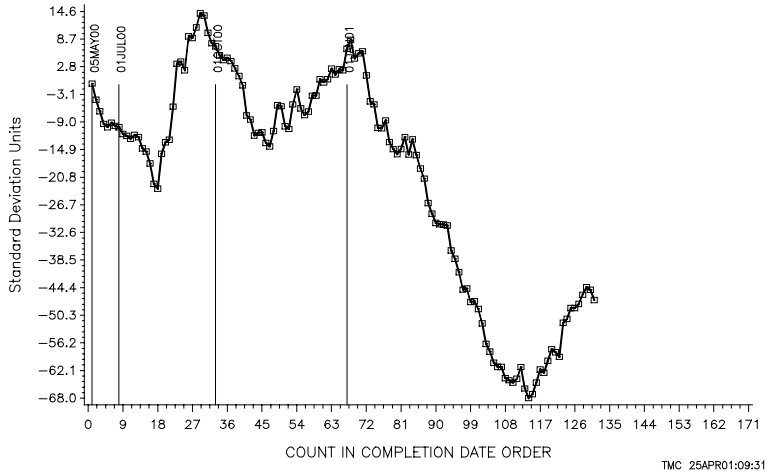
EOWT INDUSTRY OPERATIONALLY VALID DATA

Figure 14

1.0 % Water Treat Level

TEST RUN 20 – 25 ML CHANGE IN FLOWRATE AVERAGE (%)

CUSUM Severity Analysis



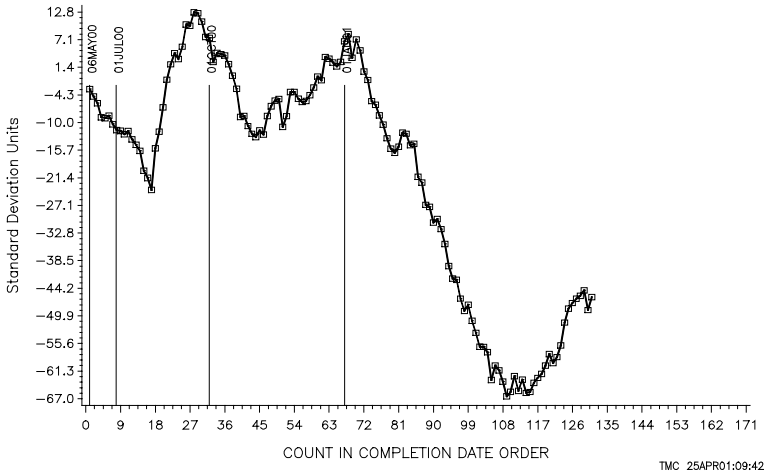
EOWT INDUSTRY OPERATIONALLY VALID DATA

Figure 15

2.0 % Water Treat Level

TEST RUN 20 – 25 ML CHANGE IN FLOWRATE AVERAGE (%)

CUSUM Severity Analysis



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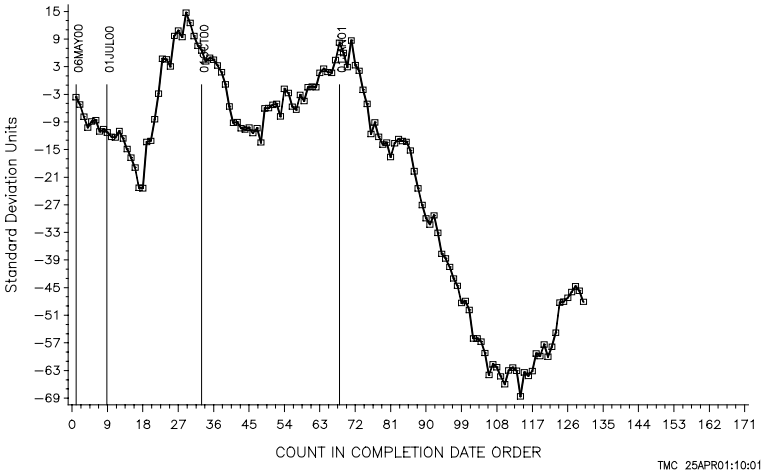
EOWT INDUSTRY OPERATIONALLY VALID DATA

Figure 16

3.0% Water Treat Level

TEST RUN 20 – 25 ML CHANGE IN FLOWRATE AVERAGE (%)

CUSUM Severity Analysis



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Attachment 2

TMC Monitored Bench Tests
Reference Oil Test Targets and Acceptance Bands

						Acceptance Bands *	
						95%	
Test	Oil Code	Parameter	n	Mean	sR	Lower	Upper
VGC by	RO #1 (51)	area % volatility loss	48	13.07	0.66	11.8	14.4
D2887	RO #2 (52)	area % volatility loss	48	6.88	0.43	6.0	7.7
Extended	RO #3 (53)	area % volatility loss	48	17.92	0.76	16.4	19.4
	RO #4 (54)	area % volatility loss	48	19.16	0.87	17.5	20.9
	RO #5 (55)	area % volatility loss	48	11.56	0.71	10.2	13.0
D6417	52	area % volatility loss	18	6.97	0.31	6.4	7.6
	55	area % volatility loss	18	11.68	0.51	10.7	12.7
	58	area % volatility loss	18	5.61	0.30	5.0	6.2
VGC by	RO #1 (51)	mass % volatility loss	10	11.85	0.47	10.9	12.8
D5480	RO #2 (52)	mass % volatility loss	11	6.22	0.23	5.8	6.7
(New Targets	RO #3 (53)	mass % volatility loss	10	16.74	0.66	15.4	18.0
Effective	RO #4 (54)	mass % volatility loss	10	17.89	0.68	16.6	19.2
12/7/1999)	RO #5 (55)	mass % volatility loss	11	10.71	0.29	10.1	11.3
D5800	52	mass % volatility loss	59	13.61	0.49	12.6	14.6
New Targets	55	mass % volatility loss	60	16.39	0.66	15.1	17.7
9/26/00	58	mass % volatility loss	59	14.46	0.52	13.4	15.5
TEOST by	AROP 124 (71)	Total Deposit wt. (mg)	27	51.79	4.79	42.4	61.2
D6335	AROP 125 (72)	Total Deposit wt. (mg)	27	26.72	3.46	19.9	33.5
MTEOS by	74	Total Deposit wt. (mg)	7	15.60	5.50	4.8	26.4
Draft 17 00.08.11	432	Total Deposit wt. (mg)	7	50.51	5.50	39.7	61.3
(preliminary	433	Total Deposit wt. (mg)	7	52.56	5.50	41.8	63.3
targets & bands)	1006	Total Deposit wt. (mg)	7	34.94	5.50	24.2	45.7
GI by	VSO #1 (51)	Gelation Index	35	63.3	12.0	39.8	86.8
D5133	VSO #2 (52)	Gelation Index	35	4.5	0.2	4.0	5.0
	VSO #3 (53)	Gelation Index	37	44.7	4.6	35.6	53.8
	VSO #5 (55)	Gelation Index	36	22.3	4.8	12.8	31.8
	AROP 111 (62)	Gelation Index	35	17.0	3.9	9.4	24.6
D6082	HTFF (1002)	Tendency (ml)	32	410.63	58.78	295	526
(HT FOAM)	HTFF (1002)	Stability (ml)	32	37.81	45.41	0	127
D6082	HTFF (1007)	Tendency (ml)	28	65.71	19.28	28	103
(HT FOAM)	HTFF (1007)	Stability (ml)	28	0.00	0.00	0	0
BRT by	81	Average AGV	12	112	14.00	85	140
D02-1483	1006	Average AGV	12	128	7.21	114	142
(D6557)	5A-3	Average AGV	12	76	6.47	63	89
EOFT by	77	Δ Flowrate (%)	12	-45.55	4.36	-54.10	-37.00
(Draft 6)	78	Δ Flowrate (%)	12	15.74	6.87	2.27	29.21
EOWT by	77	0.6% H20 Δ Flowrate (%)	12	-24.90	5.68	-36.03	-13.77
(Draft 5)	77	1.0% H20 Δ Flowrate (%)	12	-17.94	5.45	-28.62	-7.26
	77	2.0% H20 Δ Flowrate (%)	12	-17.96	8.47	-34.56	-1.36
	77	3.0% H20 Δ Flowrate (%)	12	-18.23	6.83	-31.62	-4.84
EOWT by	78	0.6% H20 Δ Flowrate (%)	12	10.87	6.16	-1.20	22.94
(Draft 5)	78	1.0% H20 Δ Flowrate (%)	12	7.54	6.15	-4.51	19.59
	78	2.0% H20 Δ Flowrate (%)	12	5.17	5.33	-5.27	15.62
	78	3.0% H20 Δ Flowrate (%)	12	-0.54	4.52	-9.40	8.32

TMC Monitored Bench Tests – Individual Reference Oil Statistics
(Operationally Valid tests Only)

Test	Oil Code	Parameter	Targets			4/1/98 - 3/31/99			4/1/99 - 3/31/00			4/1/00 - 3/31/01		
			n	Mean	sR	n	Mean	sR	n	Mean	sR	n	Mean	sR
VGC by	51	% volatility loss	48	13.07	0.66	7	13.4	0.45	9	13.4	0.62	5	13.1	0.95
D2887	52	% volatility loss	48	6.88	0.43	8	6.8	0.38	9	7.0	0.52	3	7.4	0.15
Ext.	53	% volatility loss	48	17.92	0.76	7	17.8	1.03	4	17.4	1.35	5	18.8	0.64
	54	% volatility loss	48	19.16	0.87	9	19.3	0.94	6	19.3	1.18	4	19.1	0.76
	55	% volatility loss	48	11.56	0.71	5	11.1	0.53	8	11.6	0.76	5	12.4	0.70
D6417	52	Area % Volatized	18	6.97	0.31	-----	-----	-----	-----	-----	-----	6	7.1	0.71
	55	Area % Volatized	18	11.68	0.51	-----	-----	-----	-----	-----	-----	5	11.8	0.50
	58	Area % Volatized	18	5.61	0.30	-----	-----	-----	-----	-----	-----	7	5.9	0.21
VGC by	51	% volatility loss	10	11.85	0.47	3	11.4	0.51	3	11.9	0.75	1	10.7	-----
D5480	52	% volatility loss	11	6.22	0.23	4	6.2	0.27	2	5.8	0.28	2	6.2	0.14
*	53	% volatility loss	10	16.74	0.66	4/3	15.5/16.7	2.59/1.26	2	16.4	0.00	1	16.1	-----
	54	% volatility loss	10	17.89	0.68	2/1	15.0/17.7	3.82/----	2	18.2	0.35	1	18.1	-----
	55	% volatility loss	11	10.71	0.29	4	10.6	0.19	2	10.8	0.42	2	11.2	0.49
D5800	~~51~~	~~% volatility loss~~	~~36~~	~~18.13~~	~~0.42~~	~~5~~	~~18.5~~	~~0.33~~	~~7~~	~~18.3~~	~~0.23~~	-----	-----	-----
**	52	% volatility loss	59	13.61	0.49	4	13.6	0.47	6	13.8	0.51	13	14.2	0.58
	~~53~~	~~% volatility loss~~	~~36~~	~~22.30~~	~~0.55~~	~~8~~	~~22.4~~	~~0.59~~	~~2~~	~~22.6~~	~~0.21~~	~~2~~	~~22.6~~	~~0.35~~
	~~54~~	~~% volatility loss~~	~~36~~	~~23.54~~	~~0.67~~	~~6~~	~~23.9~~	~~0.88~~	~~8~~	~~24.4~~	~~0.46~~	~~3~~	~~24.5~~	~~0.36~~
	55	% volatility loss	60	16.39	0.66	5	16.5	0.40	10	16.6	0.45	15	16.9	0.73
	58	% volatility loss	59	14.46	0.52	-----	-----	-----	-----	-----	-----	15	14.8	0.80
TEOST	71	Deposit wt. (mg)	27	51.79	4.79	19	47.4	7.06	16	49.1	6.38	9	52.4	11.36
(D6335)	72	Deposit wt. (mg)	27	26.72	3.46	17	26.7	3.54	14	30.0	4.73	9	29.1	3.69
MTEOS	1006	Deposit wt. (mg)	7	34.94	5.50	-----	-----	-----	-----	-----	-----	17	34.0	6.13
	432	Deposit wt. (mg)	7	50.51	5.50	-----	-----	-----	-----	-----	-----	13	46.5	9.87
	433	Deposit wt. (mg)	7	52.56	5.50	-----	-----	-----	-----	-----	-----	11	47.4	5.63
	74	Deposit wt. (mg)	7	15.60	5.50	-----	-----	-----	-----	-----	-----	11	15.0	2.20
GI	51	Gelation Index	35	63.3	12.01	15	56.2	12.82	16	62.3	10.90	12	60.3	6.22
(D5133)	52	Gelation Index	35	4.5	0.24	15	4.4	0.23	12	4.4	0.19	9	4.4	0.12
	53	Gelation Index	37	44.7	4.64	12	46.4	3.69	12	47.6	2.26	13	47.7	6.88
	55	Gelation Index	36	22.3	4.84	11	24.1	2.49	12	23.0	5.34	15	20.2	7.46
	62	Gelation Index	35	17.0	3.90	15	17.2	4.51	10	18.1	3.48	16	16.2	4.71
D6082	1002	Tendency (ml)	32	410.63	58.78	29	386.9	71.38	9	422.2	78.86	17	495.6	232.46
	1002	Stability (ml)	32	37.81	45.41	29	19.7	48.88	9	37.8	62.80	17	182.9	225.47

* D5480 Targets Adjusted 12/7/99 per direction of the Volatility Surveillance Panel

**D5800 Targets Adjusted 10/2/00; new oils selected; new procedures approved

TMC Monitored Bench Tests – Individual Reference Oil Statistics
(Operationally Valid tests Only)

Test	Oil Code	Parameter	Targets			4/1/00 - 9/30/00			10/1/00 - 3/31/01		
			n	Mean	sR	n	Mean	sR	n	Mean	sR
BRT	1006	Average AGV	12	112	14.00	7	123.1	5.30	26	123.7	6.79
	5A-3	Average AGV	12	128	7.21	7	82.0	12.03	31	81.6	13.72
	81	Average AGV	12	76	6.47	14	121.0	11.50	55	121.0	6.06
EOFT	77	Avg. % CF	12	-45.55	4.36	26	-32.4	8.56	5	-18.5	7.03
	78	Avg. % CF	12	15.74	6.87	27	17.9	6.24	74	15.1	4.64
EOWT	77	0.6 H2O Avg. %CF	12	-24.90	5.68	18	-25.6	6.19	53	-23.8	4.71
	77	1.0 H2O Avg. %CF	12	-17.94	5.45	15	-17.4	6.72	45	-17.8	5.25
	77	2.0 H2O Avg. %CF	12	-17.96	8.47	17	-18.1	6.26	50	-17.0	6.72
	77	3.0 H2O Avg. %CF	12	-18.23	6.83	16	-21.7	4.96	48	-18.4	6.19
EOWT	78	0.6 H2O Avg. %CF	12	10.87	6.16	16	11.2	6.32	48	8.6	6.46
	78	1.0 H2O Avg. %CF	12	7.54	6.15	17	8.4	7.21	54	5.3	6.30
	78	2.0 H2O Avg. %CF	12	5.17	5.33	14	4.5	4.74	50	2.8	5.75
	78	3.0 H2O Avg. %CF	12	-0.54	4.52	16	3.8	6.37	50	-0.6	5.22